POPULAR AVIATION

Including SOUTHERN AVIATION and AERONAUTICS

A MAGAZINE FOR THE PROMOTION OF AMATEUR AVIATION AND PRIVATE FLYING

Volume XIV | MAY, 1934 | Number 5

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POPULAR AVIATION, Volume 14, Number 5, May, 1934. Published monthly by Aeronautical Publications, Inc., at 608 South Dearborn Street, Chicago, U. S. A. William B. Ziff, Publisher; B. G. Davis, Editor; John B. Rathbun, Managing Editor. New York Office, 551 Fifth Avenue, New York City. Subscription $2.50 per year, single copies, 25 cents, foreign postage, $1.00 per year extra. Contributors are especially advised to retain copy of their contributions, which must be accompanied by return postage. All such material will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Any copy accepted is subject to revision or changes to meet the requirements of this publication. Payment for copy used will be made at our current rates. Entered as second-class matter, January 24, 1933, at the Post Office, Chicago, Ill., under the act of March 3, 1879.

How Many "Hawks" Have Been

by

HERBERT F. MADEN

U. S. Army Air Corps Photo.

This is the Curtiss Hawk Type P-2 equipped with a Curtiss V-1400 engine. This is one of the early developments.

OF all the modern fighting planes, probably none attracts as much attention amongst scrapbook collectors and most aviation enthusiasts as does the Curtiss Hawk Pursuit plane of the U. S. Army and Navy.

And why not? Here is the plane that has been accepted as the standard fighting plane of both branches of the service, as well as several foreign countries, for more than a decade (which goes back before the memory of many collectors).

From a collector's standpoint, here is another important reason: There have been some thirty-five more or less distinct Hawk types and, on a rough estimate, some five hundred planes were built since their inception in 1923. A collection that includes all of these types, along with the various markings such as: different squadron insignias, markings of the many countries that have used them and the different planes with test equipment installed, is indeed quite an extensive special collection, one that anyone can be proud of.

The design of the Hawk plane was laid out, two test models were constructed in 1923 and turned over to the Army for tests.

These planes, the XPW-8, were two-bay biplanes of more or less conventional construction and were equipped with wing type radiators and powered with 435 h.p. Curtiss D-12 engines.

The XPW-8 showed a top speed of 161 m.p h., which, considering the fact that special built racing planes were just passing the 200 m.p.h. mark, was no bad speed for a fully equipped pursuit plane. These planes were successful in passing their tests, and with a few minor changes went into standard production in 1924 as the PW-8, they were used to equip the First Pursuit Group at Selfridge Field. Incidently, one of these planes was used by Lieut. Maguhan to complete the first Dawn-to-Dusk-Flight, New York to San Francisco, in 21 hours, 48 minutes, on June 23, 1924.

The wing type radiator is one invention that has proved very very successful on racing planes (it is doubtful if speed records of today would be possible without it) and an almost total failure on commercial planes. The reason, of course, is their delicate construction which makes them short lived, unreliable and expensive to keep in working order.

The Army found this out after the PW-8's had been service use for a short time. So, in 1925, the Curtiss Company redesigned and built two new models, the XPW-8A and the XPW-8B, in which this trouble was corrected. The XPW-8A was a single-bay biplane, somewhat similar to the PW-8, but it had less wing area and was equipped with an underslung radiator. Due mostly to the reduced wing area, it showed a top speed of around 170 m p.h.

The XPW-8B was similar to the XPW-8A except that the wing was changed to a taper in both chord and thickness. This was done in order to increase the maneuverability of the plane. Of the two, the XPW-8B was finally accepted as the better plane and it went into production as the P-1.

From the XPW-8B has grown the various Hawk planes as we know them today. Changes have been made from time to time, as suggested by service use and to keep them up to date, but in construction and appearance they are all very much alike, the main difference being in the engines.

The Curtiss shops also built a new model, the P-2, for the Army and adapted the P-1's for Navy use in 1925. The P-2 was similar to the P-1 except that it was powered with a 510 h.p. Curtiss V-1400 engine. It showed a top speed of 172 m.p.h. For some reason of which I'm not aware, the P-2 wasn't so popular and only five of the planes were built.

The two planes, the F6C-1 and the F6C-2, adapted from the P-1 for Navy use, were virtually the same as the P-1. The F6C-1 showed a top speed of 167 m.p.h. as a landplane and 160 m.p.h. as a seaplane. The only difference between the F6C-1 and the F6C-2 was a specially designed deck landing-gear on the F6C-2.

The Curtiss-Aeroplane & Motor Cor-

U. S. Army Air Corps Photo.

Another step in Curtiss Hawk development, the Type XP-3A. An early Hawk with an air-cooled radial engine.

Designed, Built and Tested?

HERE is a treat prepared for our Photo Phans by another Photo Phan. It is an illuminative history of the various Curtiss Hawks that have been tried out by the U. S. Army Air Corps.

U. S. Army Air Corps Photo.

The Curtiss Hawk Type P-5 with a liquid cooled engine and an external supercharger. But it is still a Hawk.

poration carried their experimentation for a suitable deck fighter into 1926. The first model brought out that year was the XF6C-3. I'm not aware of any of the construction details, except that it was powered with a D-12 motor, but only the one model was built. The next model was the F6C-3, which was based on the construction features of XF6C-3. It proved quite popular and thirty-five of the planes were built.

For the Army, the Curtiss-Aeroplane & Motor Corporation built three new models, the P-1A, the XP-3 and the XAT-4. They also shipped the first of the Hawk models abroad, with eight of the P-1A's going to the Chilean Government and one to Japan.

The P-1A was similar to the P-1 except that it was powered with a D-12C engine. The XVP-3 was the first of a long series of air-cooled engined Hawk planes. It was an experimental model similar to the P-1A except that it was powered with a 390 h.p. Curtiss R-1454 radial motor.

Others of the air-cooled series are: the XP-3A, the P-3A, the XF6C-4, the F6C-4, the P-6S, the YP-20, and the FIIC-1, all of which were more or less experimental models. And the AT-5, the AT-5A, the Turkish Hawk, and the FIIC-2, all of which were more or less successful. However, we will mention them all in turn so let's skip them now.

The other model built for the Army in 1926 was the XAT-4. As the model designation shows it was an advanced trainer, it could hardly be classed as a pursuit plane, but because it is one of the Hawk types I shall include it as well as the other Hawk trainers. The XAT-4 was an experimental model built along the lines of the P-1 and around the Wright E 180 h.p. water-cooled motor for advanced pursuit training. Its high speed was around 135 m.p.h. It proved quite successful and was produced as a standard plane during 1927 and 1928 as the AT-4. Wright J.5 motors were substituted for the Wright E motor and several more were built during this period as the AT-5 and AT-5A's.

1927 and 1928 were boom years for Curtiss as well as most other aviation companies. Including the above mentioned training planes, twelve new models were introduced. However, excepting the above training planes and the P-1B and F6C-4, they were all experimental models.

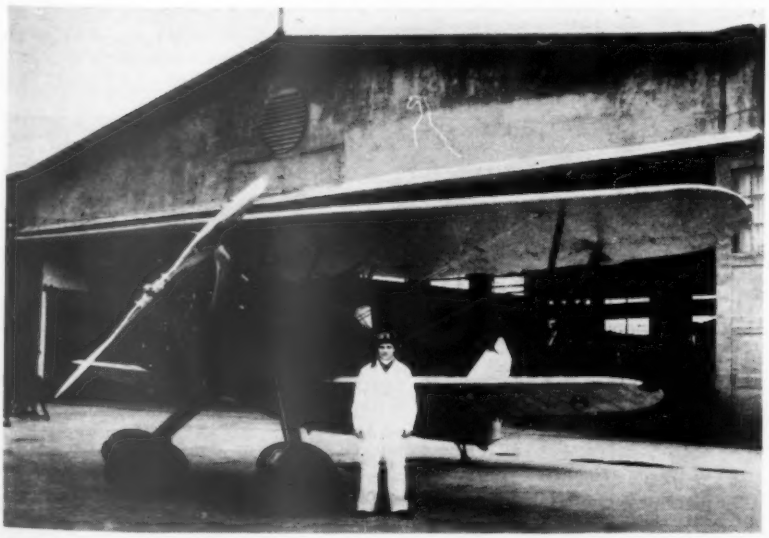
Starting at the first, there was the P-1B, which was similar to the P-1A except that it was powered with a D-12D motor. As the P-1B is the first of the Hawk planes of which I have very complete specifications, I will add them at this point. These specifications vary on the different types only slightly, due for the most part to the difference in weight, size, and power of the various motors. So after this I shall mention them only when there is an appreciable difference.

The P-1B had a wing span of 31 feet 6 inches, a length of 22 feet 7 inches and weighed 2,170 pounds empty. The high speed was 160 m.p.h. and the climbing rate was 1540 feet a minute.

Before continuing with the rest of the Hawk models produced in 1927 and 1928, I will mention briefly the rest of the P-1 series for none of them were so successful.

In 1929 the Curtiss engineers changed the nose lines of these planes and installed a D-12E motor. This plane, the P-1C, sometimes referred to as the Curtiss Conqueroring Hawk, wasn't so successful itself but it later became the bases of the P-6 series. The P-1 series also went through the P-1D, the P-1E, and (I believe) the P-1F's. However, other than that they resemble the P-1B's in appearance, I am not acquainted with the details.

Next in the 1927 presentations was the XP3-A which was similar to the XP-3 with the exception of the motor which was a 410 h.p. P & W Wasp. The XP-3A was accepted as the P-3A



One of the very recent Curtiss Hawks supplied to the Chinese Government. The demonstrator, Jimmy Doolittle is shown standing beside it.

but only five of the planes were built. This was due mostly, I believe, to the Army's opposition to air-cooled pursuit planes. It wasn't until the advent of the Boeing P-12B in 1929 that the Army ordered air-cooled planes in large quantities. Then came the XP-6. This plane was built along the lines of the P-1B but was powered with Curtiss Conqueror motors. With a 600 h.p. Conqueror motor the high speed was 176 m.p.h. With a 700 h.p. high compression motor the high speed was 191 m.p.h. However, the XP-6 remained in the experimental stages until 1930 when it was redesigned along the lines of the P-1C. It then showed a high speed of 180 m.p.h.

Now comes a plane whose history seems open to debate. I mean the XP-6A. According to William Wait, Jr., enineer for the Curtiss-Aeroplane & Motor Corporation, the XP-6A was built in 1924 as the XPW-8A but wasn't officially flown as planned until 1927 when it was raced as the XP-6A to win the Free-for-All Pursuit plane race at Spokane, Washington with an average of 201.2 m.p.h. He placed the top speed at 210 m.p.h.

Other writers have stated that it is a development of the P-1A built around a 730 h.p. Conqueror motor. Personally, I'm inclined to believe that it is the XPW-8A (the one submitted to the Army in 1925) equipped with a later and higher powered motor. Here's why: One of the first of the 700 h.p. Conqueror motors to make its public appearance was the one used on the Curtiss R3C-4 racing plane in 1926. At least I've been unable to find any mention of such a motor prior to that time.

But the only one of the Hawks that it resembles in construction is the XPW-8A. In fact, the XPW-8A and the P-6A are the only ones of the Hawks type which are single-bay biplanes, using straight wings and wing type radiators. Anyway, only the one model appeared.

One more model and we wind up the models submitted to the Army during this two-year period. This was the P-5, another little known model of the Hawk planes. It was similar to the P-1's except that the D-12 motor was equipped with an outside supercharger and designed for high altitude work. It showed a high speed of 174 m.p.h. at 25,000 feet and a ceiling of 32,000 feet.

The Curtiss-Aeroplane & Motor Corporation did very little for the Navy during this period, for only two new types were submitted. These were the XF6C-4 and the XF6C-5. The XF6C-4 was similar to the F6C-1 except that it was powered with a Wasp air-cooled motor. It was accepted and an order for 31 planes was filled for the Navy. The model designation, of course, became the F6C-4. The XF6C-5 was an experimental model similar to the F6C-4 but it was powered with a Hornet A motor. I believe only the one model was built.

(*Concluded on page* 345)

Skoda Works Build New Fast Transport

The Skoda tri-motor transport plane is a clean looking ship that bears the impress of Lockheed practice in the matter of streamlining. However, it is an all-metal ship and is provided with three Czech engines.

DURING the World War, the Skoda works at Prague, then in Austria, built the famous 42-centimeter guns that reduced the forts of France and Belgium to ruins.

Now that Prague is in Czechoslovakia the same works have turned to airplanes and their latest machine, the Avia-51, is the first European transport ship seriously to meet on even terms the challenge of the fast Boeing and Douglas ships from the United States.

As might be expected from the Skoda works, which have been famous for centuries for their skill in handling metal construction of all sorts, the new ship is an all-metal craft. It is a three-motored monoplane of the high-wing type, seating eight passengers and two pilots.

The metal is largely dural throughout the construction with stress-points of high-speed steels and the tail assembly built of steel in cantilever construction. As Skoda's research shows that most accidents to transport ships occur as the result of tail failures, hence much attention has been paid to this point. The hinges of both tail surfaces and ailerons are in ball bearings to insure better operation and the original feature of longerons, ribs and other members are their special sections, developed after long research by the Skoda engineers.

Another interesting feature is that wherever dural surfaces are exposed to the air they are plated with cadmium to insure against corrosion; cadmium being a new material in European aircraft construction and one which shows up as even more efficient than chromium for the purpose.

Fuel and oil tanks are of brass throughout, but the most interesting feature of the interior arrangement of the plane is the care which has been taken to eliminate motor noises and the success which has been achieved in this direction, in spite of the fact that the ship is a three-motor type, with one motor in the center of the fuselage.

At all points where the cabin is connected with the main structural members of the plane which carry the vibra-

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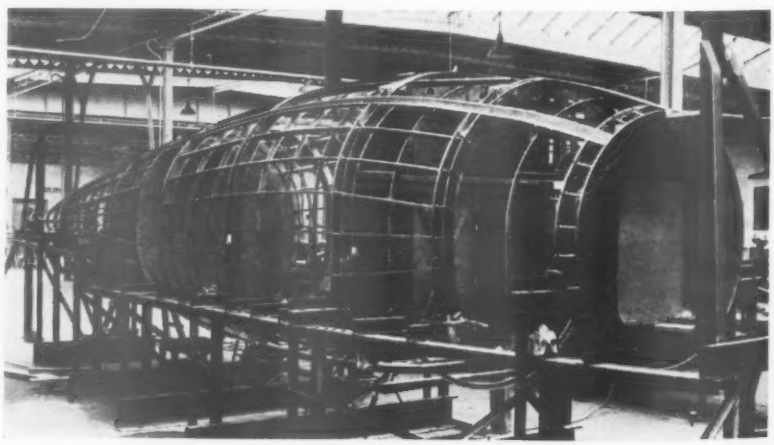


Here we have the structural members of the Skoda transport exposed to view. Note the solid bulkheads.

Our Army Air Corps Chief

by JAMES FARBER

Major General Benjamin Foulois, Chief of the U. S. Army Air Corps, is an old-timer in aviation, a practical pilot and mechanic. In short, he knows his stuff. He was our first Army pilot, and for a long time, was the only pilot.

ONCE upon a time, generals used to wave their swords and lead their men to the roaring cannon's muzzle. Indeed, a land engagement that was not marked by the fatally reckless courage of a high ranking officer was counted as hardly more than a skirmish. The casualty lists were filled with men who had won their spurs, medals and high ranks by personal daring in battle.

That wasn't so long ago. Our own Civil War left many a general dead on the battlefield. The Spanish-American war took its toll of men wearing stars and eagles on their shoulder straps. But time, customs and habits change. So does war-making, as the World War demonstrated. Today, generals direct battles from swivel chairs and off maps. Brains rather than bravery are required of leaders.

And a leader who combines brains with an intrepid spirit of daredevilry is a rarity today. A man who directs his men—then leads them in the field—must be a personality among fighting men. It is a great pleasure to introduce a man like that to you. He is Maj. Gen. Benjamin D. Foulois, Chief of the U. S. Army Air Corps!

He was commander of the A.E.F. air forces in France. Yet he rode roaring planes through European battle skies. He plans maneuvers for the army birdmen—and flies anyplace and everyplace—all alone or at the thundering head of his men. He is a hard-bitten hard-flying pilot of the toughest fiber and the highest caliber. He sets a "hell-of-a-pace" for his "boys" to follow—in one of the most hazardous arms of the service.

Unlike many modern-day generals, Foulois may go down at the head of his squadrons if his country is plunged into war again. But that is probably the way he would choose. He is a fighter through and through.

But let's get a closeup picture of this diminutive chief of our Air Corps. No better way than to accept his word for it that he prefers to be thought of as "Benny" Foulois!

What a remarkable feeling for a general officer to have. And what a tribute to his human side—"Benny." He knows everyone calls him that anyway, but he says it delights him. He doesn't growl through a general's legendary mustachios—not only because he doesn't wear mustachios as you probably know,—or could find out by examining the accompanying photos—but because it is not his nature to growl. You'd have to make him good and mad to get him in a bad humor and then his chief manifestation of ill humor is to bite his pipe and chew it with a clicking noise. Then he's a tough and wily adversary.

As boss of the Army Air Corps, it is Foulois' job to be in intimate touch with the several dozen army fields strategically scattered over the nation. He could travel 10,000 miles by air and still have a few more posts to visit.

Saddled with the prodigious task of directing the air mail, he says he expects to add about 20,000 miles a year to his travels. His present yearly average is 40,000. Since he doesn't believe in delegating his own duties to his assistants, he has an enormous job to do getting around the country on inspection tours and official visits. As Chief, he holds himself personally responsible for the maintenance of the service ideals of the corps.

A wartime closeup of Major General Foulois, then a brigadier general. He accomplished important tasks in France.

His log-book shows that, after he succeeded Maj. Gen. James Fechet as air corps chief in July, 1931, he soloed 235 hours in the first year of his tenure of office. That was only a beginning. In the second year, ending July, 1933, he hung up a score of 310 hours. Nobody can guess what he will do as the nation's premier Flying General and Flying Postman as well!

If you are a reader of the daily papers you must have often come across a paragraph such as this:—

"... Foulois, chief of the U. S. Army Corps, landed at Military Airport today. He told newspaper men just before taking off that he expected to be at Corps Field, 300 miles away, by nightfall."

If you think anybody but Foulois was flying Foulois' plane, you've got another guess coming. Benny is his own pilot and mechanic. The spare cockpit in his plane is invariably empty. He won't have it any other way—and he's the boss. It is a source of great pride with him that nobody can say he is a chauffeured general.

As a matter of fact, since he has been in office, there has been a decided jump in the number of flying hours credited to his higher ranking subordinates. It is his firm conviction that his officers can not properly understand their jobs without putting in plenty of flight hours. He frankly admits that his own strenuous activities are meant to furnish an example for them. He says leadership and knowledge of flying equipment are the best basic qualities of military pilots.

When Benny takes off from Washington for San Francisco—with stop-offs—his usual time is a day and a half. His speed average for that 310 hour mark of his was between 130 and 140 miles an hour. He likes to take about a thousand miles at a jump—or a jump-and-a-half—say, about 7 hours, or long enough for him to begin to think about his gas supply.

His greatest bugbear, he says, is the mountain of official paper work that frequently engulfs him in his Washington office. This is not only his bugbear, but it is his despair. Sometimes he is hopelessly swamped and can't brush off on a tour of the country.

"I itch to get into the air at these times," he says. "Flying is my best recreation, but if you don't think I like handball, just come over and watch me! But I find my best relaxation in my plane."

The minute he sees a loophole in the wall of paper that surrounds him, he races off to Bolling field and is off again on one of his famous sprints across the country. He will jump up from his desk at 10 o'clock in the morning and four hours later slip into Wright Field or some other post for a little visit. If the press of paper duties doesn't recall him to his headquarters, the 500-mile hop is likely enough to end on the California slope.

He never really surprises the enlisted men of the corps by these sudden descents into their midst. They have learned to expect such unexpected and

informal visits. They are always glad to see him. He probably knows more enlisted men by their first names than any other general in the army.

For that matter, they all know him by his first name, too, so to speak. He is universally and affectionately known as "Benny" wherever flying men gather. He knows this and it "tickles" him. He was an enlisted man once, himself. He knows their problems and their viewpoints. That's why he has their unanimous and enthusiastic loyalty.

Although enlisted men do not address him as "Benny," some of the old timers that he fought side-by-side with him in the Philippines and elsewhere on far-flung battle fronts, still call him "Lieutenant." They can't seem to get over the habit, he says, and he gets a big "kick" out of it.

Benny uses an observation plane known as the 0-38-F. It is a two-seater capable of a high speed of 160 m.p.h. With a stiff tail wind of course, he can be blown along his course at a much livelier clip. But he chose this particular ship for its maneuverability, its six-hour gas capacity and its excellent landing and takeoff speeds. He says:

"With that ship o' mine I can get in and out of any airport in the country without any trouble at all. And believe me, I need to some times. Once I hit one of those thunderstorms that are always popping up in the southwest. I decided the best thing in this case would be to fly right in its teeth, so I did. I had quite a time of it. Got so bad I guessed I'd better make for the nearest piece of flat ground. Finally landed in a racetrack near Muskogee, Texas. I certainly needed a ship that could land in a spot like that."

Benny is a "first" and a "last" figure in American aviation. He was the first United States army flyer. In fact, there was a time when he was the sole member of the Army air service. That was back in 1910.

And he is a "last" in that he is the last of the old timers of military flying to be pursuing the same profession. Those early ones have passed on, or retired or found posts in civil life. Benny flies on and expects to keep on until they make him quit . . . which will probably be a tough job. A law will probably have to be passed to make that come to pass.

Curiously enough, Benny originally had no intention of joining the army. His first ideas led him to apply to the navy. It came about in this way:—

Born and raised in Washington, Conn., Benny could have had a share in his father's prosperous plumbing business. But commercial life had little or no appeal for him. He wasn't sure what he wanted to do, but the Navy seemed to offer many advantages to a likely lad, so:

Benny ran away from home!

He made for New York and thence to Brooklyn. At the Navy Yard he confronted a recruiting officer. Said the officer:

"Can you box the compass?"

Said Benny: "No."

"Can you heave the lead?"

"No." Then quoth the officer:

"We're not enlisting landsmen." Just like that, he says, chuckling over the recollection. That was in 1897. He decided to return home. At the depot he was met by most of the population of the town. He was the first runaway in a generation! Maybe it was his introduction to celebrity. Certain it is that he accepted his role and enjoyed it to the utmost.

When war was declared in April, 1898, Benny could contain himself no longer. He armed himself with his brother's birth certificate—"just in case"—and set out on a bicycle for New York, determined to have another try at the Navy. At Brooklyn, where he arrived the same day, he was met by the same dour recruiting officer and plied with the same two embarrassing questions. The Navy was still "enlisting no landsmen." So that was that.

Woefully, Benny wandered up Broadway. At 14th Street where Union Square cuts a wide swath in New York's gayest thoroughfare, he saw the alluring poster of the First Volunteer Engineers. It dazzled him. Why hadn't he thought of the army before?

So the Navy's loss 36 years ago became the Army's gain today.

It was Benny Foulois who engineered the organization, legislation and expenditure of the $640,000,000 air-service appropriation after America entered the war in 1917. In July of that year he was promoted to the rank of brigadier general and sent to France to organize the shops, depots and service of supply of the A.E.F. flying force.

It was a mammoth undertaking but not too big for the man assigned to it. He got American equipment for American flyers, coordinated and dovetailed the separate units and formed the nucleus for the strong fighting organization in the air that was eventually developed.

Meanwhile, he was everywhere at once. He often dropped in on the Lafayette Escadrille—which he had managed to get transferred from the French air service—and swapped yarns with Thaw, Rockwell, Soubiran and others who had made and were still making aerial history.

He spent all the time he could in the actual theater of operations and heard plenty of bullets whistling past his ears. His only worry was that of a possible official reprimand for endangering the life of an Air Corps general — his own!

He says too much stress is laid on the horrors of the next war. All war is horrible. It hasn't changed much in that respect, he says, and believes the words ascribed to General Sherman can hardly be improved upon.

Although it is a far cry back to those days when he was the one-man air-service of the United States Army, Benny Foulois recalls those early experiences with something like gusto. He is vastly amused at the way he got started in the flying service.

Although he had never seen an airplane, young Foulois, graduating from the Army Signal School at Ft. Leavenworth, Kan., wrote a thesis about flying machines. Not only was it a lively and timely discussion of their future, but it was a treatise on their tactical and

(*Concluded on page* 340)

"It was Benny Foulois who engineered the organization, legislation and expenditure of the $640,000,000 air-service appropriation after America entered the war in 1917." LEFT TO RIGHT. Lieut. A. B. Thaw, Jr., Major Ralph Royce and Major General Benjamin Foulois, then Brigadier General.

The Oil Men Assist Aviation

by

KEITH J. FANSHIER

National authority on petroleum marketing and economics.

This Sikorsky Amphibion, belonging to the Pan American Petroleum and Transport Corporation is evidence of the great interest taken by the independents in aviation.

THERE are probably more actual sincere friends of aviation to be found today in the petroleum industry than in any other. Numerous reasons exist for this.

In the first place, both are comparatively young and still in the early evolutionary stage. More, both have the atmosphere of romance, of dash, of sturdy pioneering, of "the new day" about them. There is a very feel of comradeship, somehow, about the two, which is caught and sensed readily enough by the growing army of men who are working in connection with things that the two are doing cooperatively.

Aviation and petroleum industries are, to use the simplest and most expressive term, good friends. They are mutually aiding each other.

An industry, such as petroleum, can do much to make smooth the path of an infant such as aviation, which needs assistance at various points in the course of its development and unfolding.

Here we have petroleum—a twelve billion dollar business, stretching out in all its ramifications. It is literally true that wherever aviation needs to be there will be found some contact with the petroleum industry. With this background, is it to be wondered that oil men and oil companies are air-minded and enthusiastic over the future of air transportation?

Let us realize and admit at the outset that there is not enough business and revenue actually arising from aviation to pay the oil industry for what it is putting into it. The "take" simply is not there. But the oil industry is not going on current "take." It is going on faith, that intangible thing that has put across more things than aviation for the petroleum industry.

It probably is not detracting from aeronautics, nor from its leaders, its great pilots and navigators any credit which belongs to them to say that many of the aerial exploits which have so caught the public fancy—and many other important but less striking activities—could not have come about without oil industry's assistance.

What is the actual present consumption of petroleum products in aviation? As nearly as it can be figured by unbiased and uncolored oil industry authorities, the annual gasoline consumption of aircraft in the United States is at the rate of 55,000,000 gallons. Lubricating oil demand may be set down conservatively somewhat around 1,500,000 gallons. If all this were paid business, which of course is very far from representing the real case, the oil industry would be realizing a gross income from it of, say, as much as $10,000,000, or possibly somewhat less than that figure. (Some estimate $7,500,000.)

Under the circumstances, if half this latter figure ought to be put down as the stake that the oil industry has annually in the aviation industry, purely on the basis of cost of products furnished, it doubtless would be a fairly accurate picture of the situation. The oil industry is not kicking nor "crabbing" about the size of this stake. In fact, many far-sighted oil men vigorously favor generous increases in the amount of attention and money the petroleum industry is plowing back readily and regularly year after year.

The figures just mentioned, it must be understood, represent only a fraction of the total amount oil companies are putting in aviation. It does not cover the equipment being purchased and used, the advertising, good-will and publicity plans worked out and executed, the laboratory and research expenditures being made constantly and numerous other costs.

The bulk of the interest being shown by petroleum in aviation is on the part of what are known as the "Major Interests." The nature of aviation's development is along such lines that the majors are peculiarly favored and able to develop with it. Greater financial resources, widespread operations

This is one of the ships employed by the Standard Oil Company of California for the rapid transportation of officials and field men. Airplanes are useful in visiting new fields in unsettled country.

and large-scale expenditures are things that make such operations relatively easier for the large company than the smaller one.

There are in the United States some fifty concerns which might be rated as major oil companies. These range from the very largest, such as Standard Oil Company of New Jersey and Socony-Vacuum Corporation, each rated as a one-billion dollar concern, even on a depression basis, down to companies of considerably less than that rating.

And speaking of depression, the well-known 1929—to—? affair has not been able to overturn nor destroy the aviation plans on the part of oil industry leaders. However, this has not been an easy thing in the several recent years when the oil industry has made virtually all its entries on its financial records in crimson colors instead of jet.

The stronger and more aggressive of these major oil companies, particularly those operating on a national basis or those whose operations can be dovetailed with those of cooperating companies to give the effect of individual national operation basis, have to all intents and purposes created "foundations" for aviation. That is, they have set up definite budgets of outlays and plans for continuing support of aviation departments, and the name of numerous aces and stars of air performance now adorn the official roster of many of the nation's largest oil companies.

Much rivalry has been engendered between several of the large oil companies in hanging up new flight records of various kinds. Of course in informal competition for such records and attainments, there must of necessity be much study and research and development of better equipment and practice. All this is bound, indirectly, to have a beneficial effect on aviation. Oil companies feel that the larger the number of brilliant experienced technical brains which can be concentrated independently on aviation problems, the better are the chances of solution of the problems involved.

Among the oil companies which have been devoting particular attention to aviation and setting up the most elaborate measures for it, it might be well to mention the Stanavo Specifications

George B. Fredell (left) is the flying sales-manager for Texas-Pacific Aero Oils.

Board, a set-up of representatives of Standard Oil Company of New Jersey, Standard Oil Company of New York, Standard Oil Company of Indiana and Standard Oil Company of California. By virtue of the unusually efficient coordination of effort and the intensity of technical work devoted, these companies have been able to do notable work on improved specifications of petroleum products for aviation.

At least two other companies are outstanding in the attention they are paying to aviation. These are Texas Company and the Shell group of companies. Shell, as in the case of Standard, can be considered as a nationally-operating unit only when each of the three principal marketing companies in various parts of the nation cooperate. Shell Petroleum Corporation, covering the central part of the country, is leading in the Shell group, with Major James H. (Jimmy) Doolittle as manager of the company's aviation department.

Texas Company, with Captain Frank Hawks as aeronautical adviser, has been quite active in this relation. Speed, endurance, pioneering of new types of instruments, new routes, new methods, new construction, new materials, new ideas, new procedure, new rules, new products—all these things have come within the realm of activity of the avia-

(*Concluded on page* 328)

This Fokker, the "Golden Shell" is the property of the Shell Aviation Corporation, subsidiary of the Shell Petroleum Corporation. Fokker and Shell both are of Dutch origin.

A Noble Philanthropy

by ED NELSON

YES, it is a grand idea—but.

A group of pilots often decide that it would be sweet if something could be done to help the small towns in their attempt to build and maintain their airports. Of course, the pilots realize that, in most cases, there is no fund available for such expenditures and that additional taxation or bond issues for the purpose are not practicable nor even possible in most cases.

And again, it is not reasonable nor logical to expect the merchants of the small towns, out of their civic pride, to shoulder the burden for such attempts have previously proved disastrous to the merchants and to the towns themselves.

With all this before them, then why should the pilots be concerned about small town airports? Well, the answer is this. To the pilots, each small town airport is a safety island—comparable to the safety of small harbors to the sailors. Again, to the aviation industry they are a means of contacting the potential traveler, the private airplane owner or local dealers. To the town, the airport may be the beginning of a new local manufacturing activity and employment for the residents of the town. It is really a long step forward for any community and it is the ambition of many small towns to obtain an airport.

But let us look at the project from a practical standpoint and ask a few questions. Will the inhabitants of the small towns help to establish the airport? Experience teaches that the answer is—NO, with a big N. Will they assist an individual to build the airport? Yes, they will provide plenty of wise advice but no money.

Will the local peasantry and gentry help to support the airport by attending air-shows calling for a small admission fee? Oh, yes, they will, by parking free on the roads outside the airport and knocking the show to the best of their ability. However, some communities improve on the roadside parking idea by issuing nothing but free passes to the elect, driving the common herd with their nickles out of the county. No, nothing is to be gained by giving air-shows.

Do the inhabitants take a pride in their airport? Yes, but they will give no support to the operators, either moral or financial. The main burden of their song is that the airport is not run right and that they hope someone will come along, some day, that knows something about airports and somebody who will make it pay. The towns, as a rule, are filled with kabitzers but with few real conscientious workers. If such a worker should be found, by any chance, he is only too glad to crawl out of the job at the first opportunity, accompanied by the jeers and hoots of

(*Concluded on page* 338)

French Build A Paddle-Wheeler

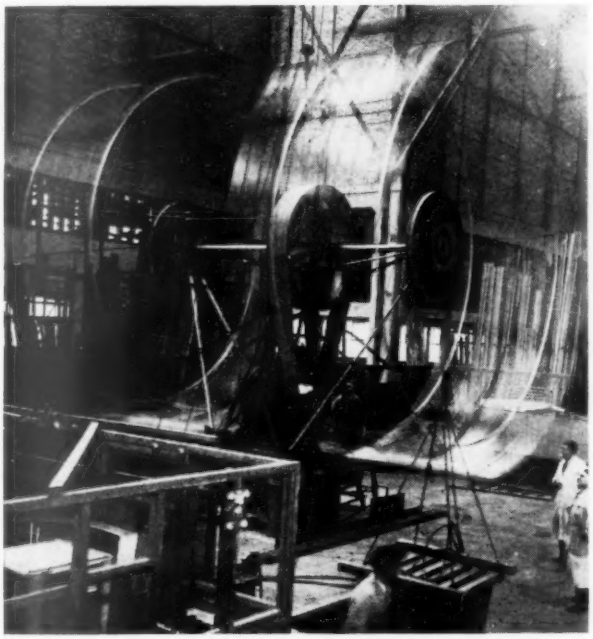
by FLETCHER PRATT

Another type of "side-wheeler" is added in France to the many types of paddle ships already designed in other countries. It will not be long before we hear the results of the tests.

THE queerest looking aircraft, since the days when de la Cierva's first autogiro began its whirling stunts in the skies around Barcelona, will soon be taking off at the great French airport of Issy-les-Moulineaux for its first flight tests.

The new ship, which is the invention of an exiled Swedish engineer living in France, C. B. Strandgren, is an aerial wheel which he claims will fulfill those ancient dreams of aviation—hovering flight over a single spot, landing straight down, flying upward in an almost straight vertical line, beside being inherently safe and incapable of side-slipping, spinning or stalling.

This has been claimed for other inventions, but the difference in the present case is that the French Air Ministry has given the strange craft exhaustive tests and has officially declared it will do everything the inventor says it will do; and the firm of Liore et Olivier, one of the largest airplane makers of France, is backing the inventor and building the trial machines at its own expense.



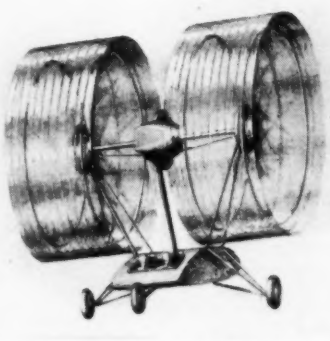
A shop test being made on the full-size Strandgren paddle-wheel in France at which the lifting qualities of the wheel are said to be satisfactory.

The Strandgren machine has neither propeller nor wings. It is flown by means of two enormous wheels, like the paddle-wheels on an old style steamboat. Each of these wheels has either five or ten spokes (five in some models, ten in others). At the end of each spoke is a small airfoil, like a miniature section of an airplane wing.

These airfoils are mounted with the spokes of the wheel at their centers, and wires attached to the leading and trailing edges, through which wire control is effected.

When all is ready for the flight the pilot throws in his motor. The wheels begin to whirl. The angle of the airfoils at the ends of the spokes changes with relation to the center of the wheel as it whirls. At the top of the wheel the airfoil is exerting both lift and drag, thanks to its forward motion. On the forward and down sweep it exerts pull for propelling the machine forward. On the first quarter of the upstroke its angle changes and due to this it does not exert backward pull during this part of the stroke but merely rides along. On the second quarter of the upstroke it exerts lift again.

There is an eccentric at the center of the wheel, the position of which can be controlled from the pilot's seat through a system of gears. When the eccentric is dropped, so that the center of the spokes no longer corresponds to the center of the wheel, there is a great deal of upstroke and very little forward stroke, so that the whole force practically passes into lift. The machine now rises vertically, or hovers if the engine is throttled down. The eccentric also permits the wheel to be set for backward flight, or for forward flight at considerable speeds.



A complete model of the paddle-wheel ship which was successful.

With a dead motor, the wheel, like that of Cierva's Autogiro, continues to revolve automatically and the plane settles down gently in a perfectly straight line.

Tests conducted by the French Air Ministry on Strandgren airwheels showed that the lift exerted, when the wings had an aspect ratio of 6 only, was within 80 percent of the mathematical maximum possible; a ratio far higher than that of any existing airplane. After the machine had been tested in this fashion on a small model, both in still air and in the highest wind-speeds that the big wind-tunnel at the Ministry could develop, the government gave its approval to the idea, and the Liore et Olivier firm took the machine up. Their first effort was with a full-sized wheel having a diameter of 18 feet, sufficient to fly a one-man airplane. Tests showed that the efficiency of the large machine was even greater than on the small models previously tested, and construction of a plane to be flown by the Strandgren system was immediately begun.

Paddle-wheel ships are nothing new. In fact the original machine of this type is an American invention while Rohrbach has also made extensive experiments with the idea. The design of a machine of this type, however, introduces certain difficulties that are not easily solved without further experimental work.

For example, the planes travel in a circular arc and certain of them work in disturbed air set in motion by the preceding paddles, so that we cannot work out a formula based directly upon wing lift. Again, centrifugal force comes into the problem so that the exact loading of the lifting surfaces is indefinite.

Then comes the matter of stress which is quite severe on a structure subjected to such high speeds and tremendous gyrostatic couples as will be created when the ship is maneuvered. The slightest unbalance, at such a great radius will also cause trouble.

It is now near completion, and will be supplied with a 130 hp. motor when finished.

END.

A New Aspirant for the $700 Class

Rear view of the "What-it" canard pusher-type plane: Note the swept back wings and the location of the elevator in front of the plane. The sweep-back improves the longitudinal stability.

THIS canard type pusher-lightplane has been aptly named the "What-it" by its designer, Waldo D. Waterman, Santa Monica, Cal. At first glance it is difficult to determine which is the front end or whether it is coming or going.

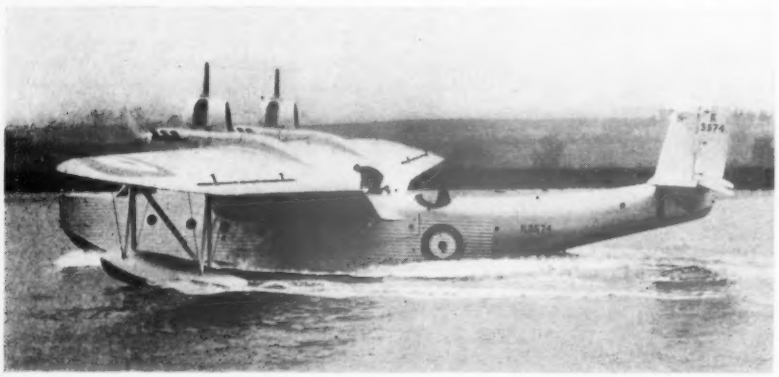
Its swept back wings project it partly into the flying-wing class, but the front elevator reacts against this classification. Its barrel-like nacelle accommodates two, a passenger and pilot, with the radial air-cooled engine at the rear. Its speed is said to be over 100 m.p.h. and it is said to put up an excellent performance in spite of its odd appearance.

A New English High-Wing Boat

HERE is a new flying boat just launched at Rochester, Kent, England, one of the first English boats of the high-wing monoplane type. It is driven by two Rolls-Royce engines arranged tractor fashion, which, by the way, are steam-cooled by condensing steam in the small radiators.

Steam cooling is not altogether new, for it was used on the old Antoinette, way back in 1910, but this system has not been used for some time. The use of the high temperature steam makes it possible to employ smaller cooling surfaces, for the same amount of heat transmitted, than when low temperature water is used. This also improves the efficiency of the engine and reduces the overall weight of the power plant.

This is a seaworthy type of boat, which in most essential details, varies from the biplane practice which has characterized British construction for many years. Note the open cockpit



The new English flying boat which has many points of novelty, unusual to English practice. Note the neatly faired engine nacelles faired into the wings.

Safety Rules for Air Races

SPECIAL rules for air races and air meets, designed for the safety of spectators and to make certain that the landing area and the air in the vicinity of the airport will be clear and unobstructed for participating pilots were announced by the Director of Aeronautics, Department of Commerce.

Any airport, at which a series of air races or other aerial demonstrations is to take place, will be divided into two parts; one for spectators and the other for the participating aircraft. Race officials will be responsible for maintaining this segregation.

Col. J. Carroll Cone, Assistant Director of Aeronautics in charge of air regulations, explained that this and other requirements are embodied in a set of rules and regulations governing air races, air circuses or demonstrations operating under waivers of the Air Commerce Regulations which are effective immediately.

Airmen approaching airports, at which air races or demonstrations are in progress, will be notified of that fact by prominent ground markers and these markings will inform airmen whether or not it is permissible for them to land. Air meet officials are required by an amendment to the Air Commerce Regulations to provide these markings.

If the airport is available for landings by airmen who are not participating in the meet, a large white "O" will be displayed on the ground near the home pylon or the announcer's stand, or the entire word "OPEN" may be spelled out in large white letters. If non-participating pilots are not to attempt landings, the marking will consist of a large white "X" or the word "CLOSED" in large white letters. If "X" or "CLOSED" is displayed, airmen are required by the regulation to refrain from landing, and to so maneuver as to avoid any air demonstration or race that may be in progress.

The rules governing air meets and races were not written into the Air Commerce Regulations, but special authorization by the Department of Commerce is necessary for an air meet or race, and this will be granted only when the officials of the meet agree to abide by these rules.

They prohibit persons not officially connected with the meet from entering upon the operations area, require adequate policing of the airport to insure that the landing area and the air above are clear for races and demonstrations, and stipulate that participting pilots shall be made familiar with all regulations governing flying at the meet and agree to abide by these regulations.

In addition, the rules set the following limitations upon maneuvers by aircraft in races or demonstrations: Aircraft shall not fly toward, over, or within 200 feet horizontally of grand stands or spectators. Aircraft performing acrobatics or engaging in races shall

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The Bubble Sextant—Its Story

by MRS. M. T. WEEMS

An interesting story of the development of the bubble sextant employed in both navigation and avigation. Mrs. Weems is the wife of Lieut. Commander Weems, (retired), the eminent authority on navigation.

Twinkle, twinkle, little star
No need to wonder what you are:
Up above the world so high
You're my beacon in the sky.

THAT is the song of the modern navigator, for nothing is a more definite guide in night navigation than fixed stars. Either sea or air navigators may easily read in the heavens the sign posts that indicate their positions. In fact, a very slight knowledge of the stars is all that is necessary. There is no need for astronomy in the scientific sense.

In the northern hemisphere, the Great Dipper and the Pole Star form a nucleus from which the necessary navigational stars may be located. Take a simplified map of the heavens, from an atlas, and you will find the few distinct guiding stars. Familiarize yourself with the relative location of these, then on a clear night find them in the heavens. You will note their progress and it is not difficult to learn their relative positions.

Now comes the less familiar phase of the observations. The comparatively recent invention of the "bubble sextant" (Fig. 1) is the simplifier of the whole process, especially for celestial air navigation. The marine type sextant requires a visible horizon from which the observed altitude of heavenly bodies is measured. Briefly, the bubble sextant creates its own horizon from which the altitude of an observed body can be measured with fair accuracy, depending on the motion of the observer.

Right here it is interesting to note that, in a primitive way the Hawaiians had a "sextant," the purpose of which was identical with its modern counterpart. An interesting article written by Admiral Hugh Rodman, U. S. N., Retired, published in the Naval Institute Proceedings, describes it in full.

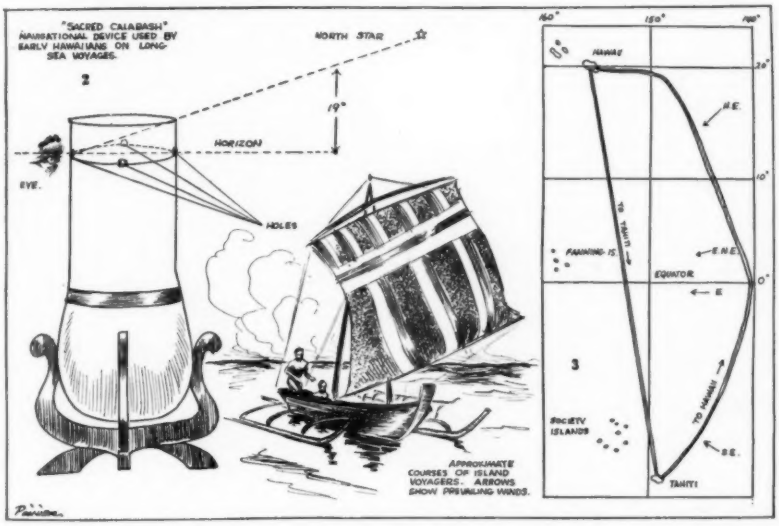

Fig. 2 shows the sacred calabash and the method of using it, together with a typical outrigger canoe. Fig. 3 shows the course sailed and the direction of the prevailing winds.

Fig. 1. The U. S. Bureau of Standards Type bubble sextant, the modern and highly accurate substitute for the sacred calabash.

Roughly speaking, if we were at the north pole, Polaris would be in the zenith or 90° overhead, and as one proceeds south from the pole, every degree of latitude covered reduces the altitude just the same amount. Upon reaching the equator, the altitude would be zero. It follows that the latitude of any place in the northern hemisphere is roughly equal to the altitude of Polaris.

Owing to the geographical position of Hawaii (approximately 19° 30′ No.), the stars of the northern hemisphere and also most of those in the southern hemisphere, except the circumpolar ones, were also visible and familiar to the natives. They had a fair conception of the movements of the stars and were taught how to shape their courses at night by them and also by the sun during the day, making due allowance for change of azimuth.

Living in the trade-wind region and as their voyage would be wholly within the trade belt, they were familiar with all conditions pertaining to meteorology. They knew that the direction of the wind varied between the northeast and southeast, depending upon the season, and that certain seasons of the year were more propitious than others for making long sea voyages.

In order to more fully comprehend the wonderful accomplishment of these primitive natives and to appreciate their endurance, resourcefulness, seamanship and navigation in making this extraordinary voyage without any of the modern aids to navigation out of sight of land for nearly the whole distance, it is necessary to familiarize oneself with the geographic location of these islands. Roughly, Hawaii is in latitude 19° 30′ N., longitude 156° 00′ W., and Tahiti, latitude 17° 30′ S., longitude 149° 30′ W., which makes the outbound course a little east of south and the distance over 2,300 nautical miles.

When the crew were considered to be in proper physical condition and when the season was most propitious, the canoe was fully equipped and loaded with such provisions as would take the least space and yet give the greatest amount of sustenance. The Sacred Calabash of Fig. 2 was taken on board amidst a grand celebration in honor of the event after invoking the

gods and making offerings and sacrifices.

A native historian of the Hawaiian Islands states that, among the instructions given to the crew before making this voyage, were: "If you sail for Kahiki (Tahiti) you will discover new constellations and strange stars over the deep ocean. When you arrive at Piko-o-wakea (Equator) you will lose sight of Hoko-paa (North Star) and Newe will be the southern guiding star. The constellation Humu will stand as a guide above you."

There were those among the crew who were especially versed in navigation from every angle known to these people. Under their advice and guidance the instructions were to steer by the sun by day and the stars by night, principally Polaris, on a course a little to the east of south. This at night would be accomplished by keeping Polaris several degrees to the left of a north and south course. Furthermore, when the celestial bodies might be obscured by clouds, knowing that the winds were generally easterly, they were to keep on the port tack or with the wind on the port side.

They also had an intimate, in fact, an almost uncanny knowledge of the looks and action of the sea, that is the effect of the wind on the waves, its duration from any one direction or its changes in direction. Still more wonderful, and I have actually seen it demonstrated, they could tell the direction of the land by its action in changing the continuity or general symmetry of the waves.

For example, in one of the south sea groups we hired a pilot for his local knowledge in entering the harbors of the different islands. Often, without telling him our destination, in going from one island to another and before sighting land, I have called him on deck and asked the direction. He invariably pointed correctly, although, as in several other equally remarkable exhibitions of his extraordinarily developed faculties, he was unable to explain how his conclusions were reached.

Nor could any of the natives in any of the groups give a clear explanation of their combination geographical and astronomical charts, which in general consisted of a number of thin strips or battens of light wood lashed or seized by cord at their crossings. Here and there, at these crossings and elsewhere, were a number of shells, some of which were movable.

It was known to the crew that, when about half way on their journey—namely when near the equator, that they would lose the North Star. Also that it would sink below the horizon and that it would be necessary for them to use certain southern circumpolar constellations. They were aware that their course should carry them through several groups of low lying islands or atolls, as in Fig. 3, and that on communication with any of these they could

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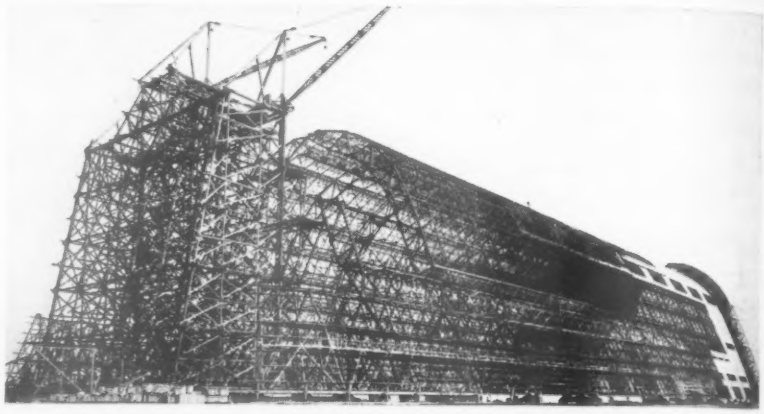
The Complex Structure of an Airship Dock

by C. W. GEIGER



Sunnyvale dock under construction showing the unique "traveler" with its derrick booms at the left. The use of the arched trusses gives a clear inside space without posts.

INTERESTING methods were carried out in the construction of the world's largest airship dock at Sunnyvale, Calif. The dock or "airship garage" will house the U. S. Macon, the largest dirigible in the world.

This dock is built up of huge arched trusses, anchored at both ends to the foundations, this construction avoiding the use of columns within the building with clear space for the airship. The main trusses are spaced 72-feet apart along the length of the building and are tied together by longitudinal (lengthwise) trusses and the purlins. The trusses are pinned at three points for expansion and contraction without straining the foundation.

Angular windbracing is then run in every direction to tie the trusses and longitudinal bracing together against wind coming against the ends of the building. Then come the "rafters" to which the siding is attached so that the assembly is a highly complex structure. Both ends of the building are closed by huge rolling doors.

The "traveler" or moving tower employed for the erection of the building is a tremendous affair. The movable tower on which the derricks are carried also served as a falsework for holding the trusses. The moving tower runs on railroad tracks along the length of the building, eight railroad cars running on four lines of track being required for this purpose. On top of the tower are three swinging boom derricks.

Plane Plays Milkwagon on Long Island

DURING the great blizzard that struck New York and the eastern states, during the latter part of February, it was found exceedingly difficult to get food to the smaller towns because of the snow-blocked highways.

With the snow 16 feet high in places, the transit lines were tied up on Long Island and hunger stalked the land. But Pilot J. E. Thropp, III, helped to solve the problem by flying milk from Plainsboro, N. J., to Roosevelt Field, Mineola, L. I., for use in the hospitals in that vicinity. From all appearances, the contents of the plane go a long way in filling the place of the milkwagon.

Here's the aerial milkman helping out in a snow-bound area with the snow piled high on every side. Aviation's latest triumph.

Some Recent Ground Trainers

by ARCHIE BREWER

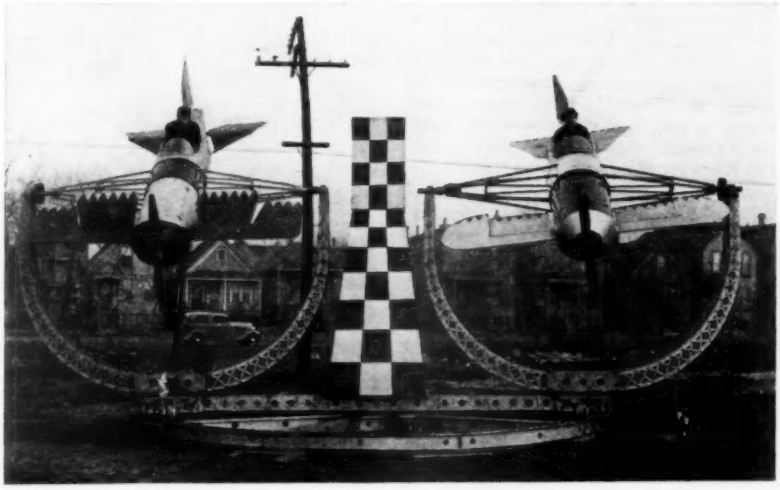
Ground trainers are going to be a prominent figure on the landscape of this summer's activities according to the dope that's going around. Let's get acquainted with two of the most original types.

DURING the past year there have been a number of "ground-trainers," or what-do-you-call 'ems devised, invented, created and just plain built. These are the doo-dads that reproduce the various antics of an airplane in distress, the only difference being that the trainer pilot is anchored firmly and safely to terra-firma.

Some are designed with a view of improving the aviation student's dexterity with the controls, thus giving him some practical work with the stick and rudder before he takes to the air. Other of these devices are admittedly entertainers or boosters for exultant spirits at fairs, street carnivals and the like. But whatever they are and for whatever they are intended, they are very interesting from a mechanical standpoint and often have real merit.

Just before I start out with a description of two new trainers, a rather amusing story must be pushed off my chest. This story relates to a big husky transport pilot of some 3,000 air-hours experience who contemptuously tried to ride one of the old type bucking trainers at a fair. Well, at the end of the first round they pulled him out—defeated and all mussed up—licked by a trainer with one foot on the ground. The next day he went raving back, tried a parachute leap from the dingus and broke a leg. So it all goes to show that these buzz-wagons are not as easy to control as they may appear.

But the brand new "Ace-of-the-Air" that we are about to describe has no such bad tricks but gives actual training in miniature ships that have a full three-plane freedom. In technical language, it can roll around the X, Y and Z axes just like a free plane in the air. It can loop, spin, roll and perform all of the standard airplane maneuvers.



No, there'll be no collision on this "Ace-of-the-Air" trainer, because it isn't built that way. The worst that can happen here is to come to a dead stop.

It consists of a miniature single-seated plane or planes, arranged within a fork or gimbal, the gimbal in turn being free to rotate around its own axis, while at the same time it runs around the central pylon on a circular track. At the same time the plane is pivoted to the tines of the fork so that it can dive, climb or loop.

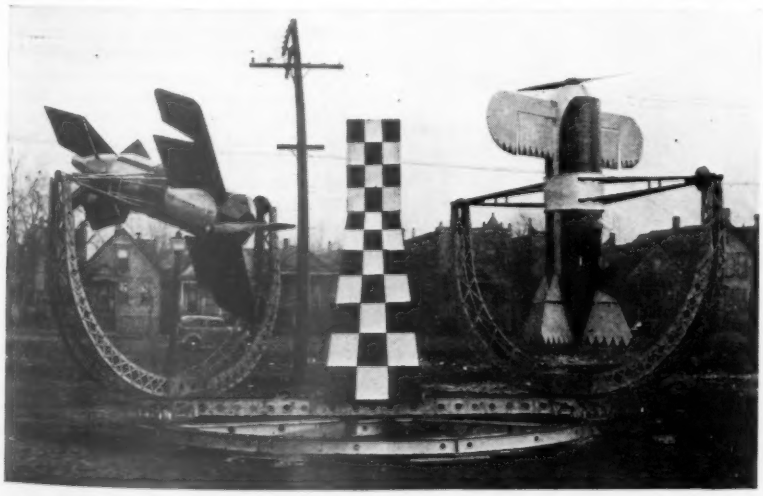
By applying the ailerons the plane can roll over within a collar that embraces the fuselage. The effect of forward speed is obtained by running the ship around the circular track while the application of the vertical rudder can swing it to the right or left. Perfectly simple and perfectly safe.

As shown in the accompanying photograph, two of the airplanes are mounted on opposite sides of the track but single units are also made. The planes are of all-metal construction throughout except the wing and tail assemblies, the latter being of tubing covered with heavily doped fabric.

The wings have a span of 11'-6". The length is 10'-6" and the track diameter is 18'-0". It is arranged so that it can be quickly assembled or dissembled, making it thoroughly practicable for traveling shows or exhibition purposes. The planes are powered with a 7½ h.p. electric motor which gives them plenty of speed and maneuvering qualities. Charles Wilford, Chicago, is the designer of this attractive outfit.

Next, we have the "New Aero Ride" developed by Stanzel and Barborak, Schulenburg, Texas. This arrangement is considerably different than the first trainer, for it rotates about a circle while attached at the end of a counterweighted pivoted arm. The plane itself is a two-place sport-type cabin monoplane powered with a five horsepower electric motor that shoots it around at a good clip.

The pivoted beam allows the ship to move up and down vertically, while a hydraulic check allows only a limited rate of movement up or down. Stabilization is affected in windy weather by a device on the opposite end of the beam. This consists of a horizontal



Here we have the "Ace-of-the-Air" trainer hard at work "stunting." At the left is a bank while at the right is a zoom. The operator can turn them into almost any position while whirling around the central pylon.

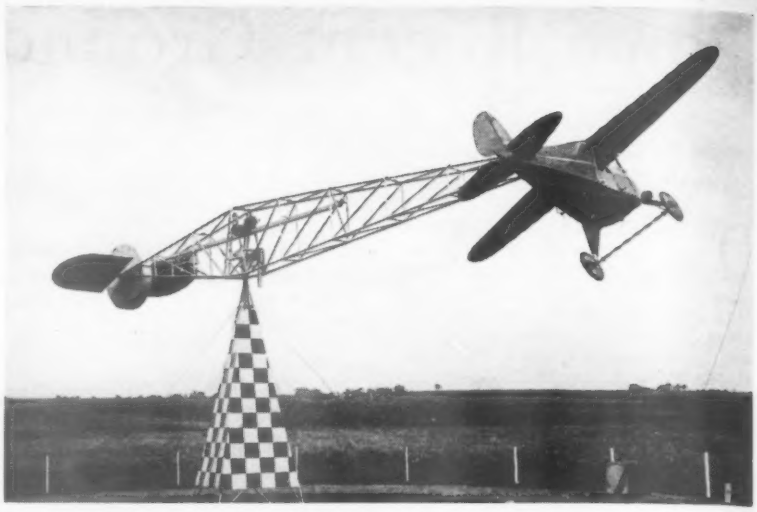
surface attached to the beam at the same angle as the wing of the plane, thus counteracting the pressure when the plane banks into and away from the wind. At the same time a vertical surface counteracts the drag of the airplane going against the wind, increasing the air-speed at this time and also decreasing the speed when the plane is flying with the wind.

The counteracting vertical fin is in the form of a tank of water to counterbalance the weight of the airplane. A second adjustable counterbalance, moved by a reversible ¼ h.p. electric motor, is provided to balance the varying passenger load. The latter is under the control of the attendant.

When the passengers enter the plane the operator adjusts the counterbalance so as to reduce the load on the ship. The plane motor is then started, whereupon the ship starts to taxi about the runway, and when it reaches about 20 m.p.h. it takes off naturally and flies in a circle around the pylon. No part of the supporting mechanism is visible to the passengers and thus the illusion of free flight is complete. By the proper adjustments the plane can be made to fly at elevations of from 1 to 25 feet.

Operable controls are installed by which the ailerons can be moved so that the plane will zoom and dip in quite a business-like way. When the motor is cut or throttled, the plane glides down and makes a perfect landing.

The construction is a typical airplane construction with a welded tubular steel fuselage and wood wings. The entire ship is fabric covered, while the stabilizing surfaces are built-up just like those of a real airplane. The beam, stand and universal joint are fabricated from steel tubing with all joints welded. The beam is in two pieces to facilitate shipping and handling.



The Stanzel-Barborak trainer in full flight, around and around the central pylon. He can maneuver or land just like a real plane.

In our last issue, we gave a brief description of the Bisch trainer which differs considerably from the two trainers shown in this article. The Bisch trainer is a miniature airplane suspended from a steel trestle and has many degrees of freedom. It is driven either by an electric motor or a gasoline engine and is said to duplicate the flight and control of an airplane very closely.

Previous to this time, the great majority of the trainers were what might be called "pedestal" types or small airplanes mounted directly upon the top of a pedestal or column. This class embraced the Great Lakes, Eyerly and Bethlehem trainers, but they were deficient in the sense that they could only dive, roll and loop about a fixed axis without any equivalent of forward motion. This deficiency, of course, dispelled any illusion of flight and therefore were very limited in their appeal.

In order that the ground trainers have value as trainers, they must be free to move in every direction that a plane can move in. They must be able to "yaw" about the vertical axis, must be able to roll about the longitudinal axis and dive or zoom about the axis passing through the center of the wings. Then, to completely simulate flight, they must also have "motion of translation" which, in short, means forward speed or travel around a circle.

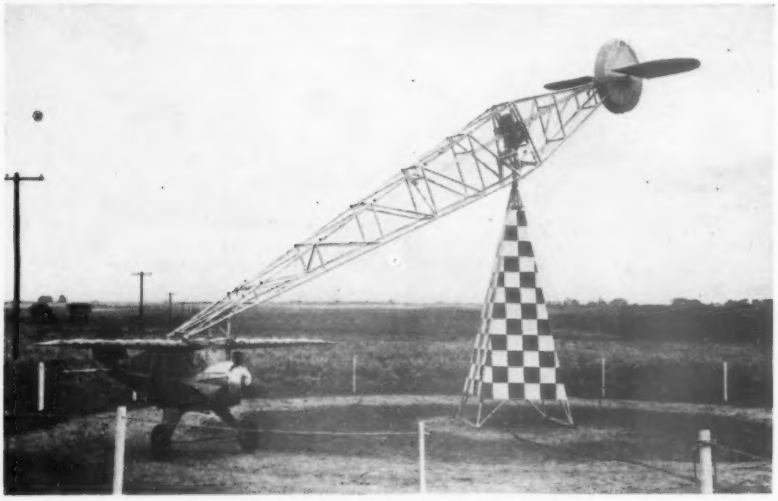
From the time that A. C. Beech made the first wind-tunnel type trainer, 'way back, years and years ago, there has always been a question as to whether the trainers actually gave real training to beginners. This, however, applied to the pedestal machines of the early times which admittedly fell rather short of actual flight maneuvering since they lacked the element of translational motion.

With the later type machines, including the trainers shown here and the Bisch trainer, the student really gets flight training and a knowledge of the controls. Undoubtedly, a few hours in these trainers will clear up the mystery of the controls at less expense and with better all around results than can be obtained with the conventional penguins.

As an amusement device, pure and simple, it has a great appeal to crowds at fairs, amusement parks and street carnivals. It has the novelty, the pep and dash that is entirely lacking with the old time Ferris wheels, coasters or similar rides. The fact that it simulates an airplane with airplane controls is a sufficient inducement for the crowds to try their hand at the latest and most thrilling of vehicles.

I believe that the ground trainer is one of the most effective of devices for spreading airmindedness abroad. Once the beginner gets the "hang" of the controls, he immediately aspires to higher things—namely, the real airplane. This proved to be the case with a very primitive trainer exhibited at a large amusement park in Chicago, two or three years ago. The crowds kept it whirling continually, and the number of "repeat rides" was very noticeable.

END



All ready for the take-off on the Stanzel-Barborak ground trainer. The ship is counter-balanced by weights on the opposite end of the arm and will lift at a low speed.

The Opposed Type Engine

by GLENN D. ANGLE

PART II.

In this section of Mr. Angle's article, he considers engines of the opposed type with more than four cylinders, and discusses their advantages and disadvantages as compared with the in-line and "Vee" types.

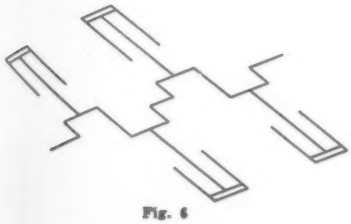


Fig. 6

IN the four cylinder engine, the arrangement in Fig. 6 has two cylinders firing simultaneously, 360 degrees apart, but in other respects this would be ideal as the resultant primary and secondary harmonics cancel out and the cylinders are spaced the same on both sides. With the same cylinder arrangement but with the four throws arranged to give four impulses, the balance would be excellent.

However, many would prefer the arrangement of Fig. 7 because of its greater compactness and simplicity of its two-throw crankshaft. Should it be planned to place opposite cylinders on a common axis and thereby cancel out the couple of the secondary harmonics, the price of an ideal combination would simply be the addition of counterweights to cancel the primary couple.

The six-cylinder opposed engine offers little to warrant serious consideration. Even intervals of firing must occur every 120 degrees of crank rotation in an engine having this number of cylinders. Thus it is at once evident that a three-throw crankshaft (with crank-pins radially spaced 120 degrees apart) cannot be employed.

Investigation discloses the fact that the crankshaft must have six throws to permit even firing intervals, and in this case, the overall length of the engine would probably measure more than some of eight-cylinder horizontally-opposed types of corresponding cylinder dimensions. Apparently there would be a great deal of wasted space in such a design.

The eight-cylinder engine probably attracts the greater amount of attention among the horizontally-opposed types. Some of the reasons for this will be explained as soon as we have determined which crank arrangements produce the best results, so now let us briefly study all of the possibilities by referring to the accompanying diagrams.

Fig. 8

When the conventional form for four cranks (as shown in Fig. 8) is adopted, we have perfect mechanical balance; but two cylinders must fire simultaneously, and the torque characteristics are therefore similar to an engine of four cylinders.

We know that the period between impulses must be 90 degrees of crank rotation to give even firing sequences in any eight-cylinder engine, therefore it is plain to see that the throws of the crankshaft must bear some sort of 90-degree relationship whenever the cylinders are positioned 180 degrees apart.

The arrangement shown by Fig. 9 satisfies this condition, and investigation further discloses that there is no rocking couple produced by the secondary harmonics if opposite cylinders are coaxial. However, there is a rocking couple due to the resultant of the primary harmonics, consequently some system of counterweights to set up an opposite couple must be provided.

Another arrangement of the cranks which insures even firing is illustrated in Fig. 10. This in reality is a double form of two-throw cranks, as illustrated in Fig. 7, with each pair of cranks in planes at right angles.

Since the secondary couple is cancelled in each pair when opposite cylinders are situated coaxially, it follows that no couples from this source set up an unbalanced condition in the engine as a whole. Each pair nevertheless have couples resulting from the primary harmonics, and suitable counterweights must be added to each in order to insure ideal mechanical balance to the engine.

The fourth and only remaining arrangement of cranks to provide even firing sequences in an eight-cylinder horizontally-opposed engine may be seen in Fig. 11. This may be recognized as the preferred crank arrangement for the eight-cylinder Vee type engine when it is desired to compensate the secondary inertia forces. In this layout we find no rocking couples introduced by the secondary harmonics, so long as opposite cylinders have a common axis; but we do find again that primary couples exist and must be compensated in order to provide proper balance.

In each of the last three examples we have similar conditions; that is, even firing sequences, no secondary rocking couples when cylinders are coaxially positioned, and primary couples which may be compensated. The choice between these three possible forms must rest, therefore, upon other considerations, so let us look into the matter further in order that we may make the proper selection.

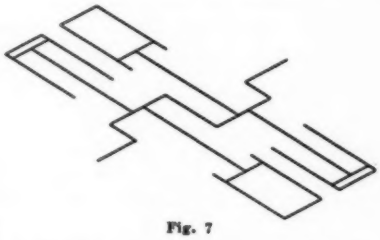


Fig. 7

First, let us determine which crank forms are the least difficult to produce, and also offer the easiest problem in securing complete balance. From a manufacturing viewpoint—judged particularly from the amount of twisting required on the crankshaft forging—the examples of Figs. 10, 11 and 9 would respectively assume these same positions in the order of their simplicity.

Balance weights at each end crank can be made to compensate the primary rocking couple of both examples shown by Figs. 9 and 10 (with the latter requiring the lesser mass); while balance weights also must be attached to the inner crank throws to produce like results in the arrangement illustrated by Fig. 11.

In all three forms, two of the cylinders in each row will fire 90 degrees apart during a complete cycle—in other words, instead of four 180-degree firing sequences in each row of four cylinders, we will have two of the alternating intervals changed to 90 and 270 degrees. From a strictly mechanical point of view, this is not a highly objectionable feature; but if we were to choose among the three, the example of Fig. 10 would seem to be the least unfavorable because the 90-degree inter-

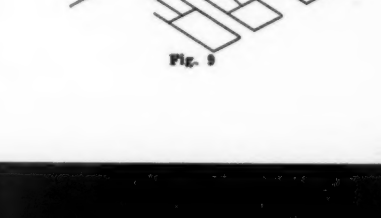


Fig. 9

val does not occur between the explosions in adjacent cylinders.

However, this choice should rest upon an even more important factor, and that is the possibility in arranging the inlet manifolds to insure good gas distribution. Undoubtedly, two carburetors or a duplex carburetor should be employed to obtain this result, hence it would be required to feed two cylinders in each row from each carburetor throat in order to evenly space the intervals of inlet valve opening in both systems.

In the form illustrated by Fig. 9, cylinders 1 and 3 in each row must be fed from one carburetor, and cylinders 2 and 4 in each row from the other. In the layout of Fig. 11, cylinders 1 and 4 in each row may be connected to one carburetor, and 2 and 3 in each row to the other.

While this in one respect permits a more symetrical manifold layout than the first example, it cannot be regarded quite as simple as the one for the arrangement in Fig. 10, where cylinders 1 and 2 in each row are fed from one carburetor, and 3 and 4 in each row receive their gas mixture from the other one.

In summing up the investigation of eight-cylinder horizontally-opposed types up to this point, we can see that there is not a vast amount of difference of a general character between the three possible crank forms giving even firing sequences, although there are probably enough special points in favor of the form shown in Fig. 10 to warrant its selection.

The ten-cylinder horizontally-opposed engine was only mentioned in an earlier paragraph so that no reader might think it had been overlooked. There is no suitable arrangement (except with ten cranks) in which such an engine could be constructed, so we shall not devote any further space to it in this discussion.

No engine considered so far possesses all the desired characteristics without the addition of a balancing means. However, the twelve-cylinder horizontal form fully satisfies all these conditions, because we not only have even 60-degree firing sequences (alternating from a cylinder in one row to one in the other) when using the conventional six-throw crankshaft, but the engine is inherently balanced to the sixth harmonics.

It is commonly known that six cylinders in line give near perfect balance, so naturally a double form would be equally as good in this respect; furthermore, opposite cylinders in the two rows do not have to be situated on a common axis.

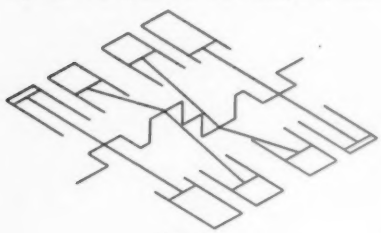


Fig. 11

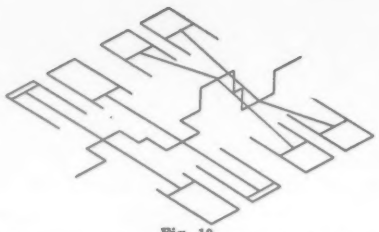


Fig. 10

A horizontally-opposed engine composed of more than twelve cylinders would be so impracticable for aircraft, there is obviously little need to take other possible forms into consideration. We have definitely determined that suitable flat engines may be built only with four, eight or twelve cylinders, and we have also determined which forms among them offer the greatest advantages.

With these important facts before us, we may intelligently proceed to examine the other factors which enter into the selection of a power plant. Only air cooling will be considered, because it is most economical in the practical power range of engines constructed in this form. Furthermore, all comparisons must be more or less of a general character since it is appreciated that even two designs of the same type may offer widely different opportunities for satisfactory installation.

The weight of a four-cylinder horizontally-opposed engine should be much lower than a corresponding four-cylinder in-line type—by virtue of the reduced length of the crankshaft, crankcase, etc., and with everything being equal, it should compare favorably as regards weight with a five-cylinder radial of the same piston displacement.

While the prospects of securing uniformly good cooling are far better than when the four cylinders are in line, this form cannot be favorably compared to the radial form in this respect. If it was possible to assume that projected frontal area represented a true measure of head resistance, we might conclude that the horizontal arrangement of four cylinders produced approximately twice as much drag as an in-line form, and much less than a radial engine of corresponding output.

However, there are no data to support any such theory, as far as the writer knows, and it seems more logical to conclude that the drag is not appreciably different among engines of all three forms which deliver approximately the same horsepower. This is not an unfair assumption when one takes into account the fact that a certain volume of air for each horsepower developed must be circulated over the walls of the cylinders to insure proper cooling, and surely more resistance is created when deflectors are used to direct the flow of air than when it is permitted to flow freely over the surfaces being cooled.

(*Continued on page 337*)

Byrd's Condor

(*See cover drawing*)

THE Curtiss Condor biplane taken by Admiral Byrd on his Antarctic expedition, is a typical Condor, modified to meet the conditions under which it is to be used.

In the first place, the standard landing gear is dispensed with, and a double pontoon or float gear is substituted for it. These all-metal Edo floats are particularly sturdy to permit landings on both water and ice. Such landing construction must be the last word in strength to take up the shock when the 17,800 pounds of weight strikes the water or ice.

Trouble was predicted when the floats were proposed, but instead, the floats behaved very nicely in the air and on the water and the ship took off the water with free elevator controls from an idling start with freedom from oscillation on the water or in the air.

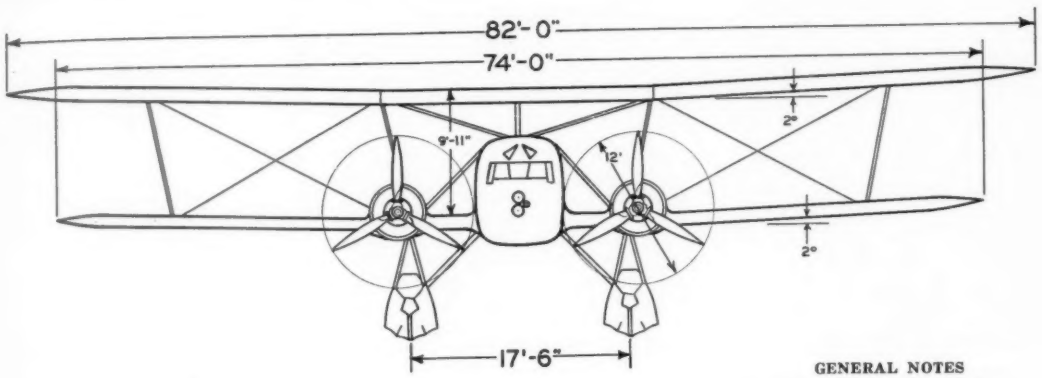
The interior is stripped of its standard decorations to save weight, and in place of the usual equipment are radio transmitters and navigational aids not ordinarily supplied.

Pilot T-999 Paints His House

Scale Drawing of Byrd's Condor

(See Cover Drawing)

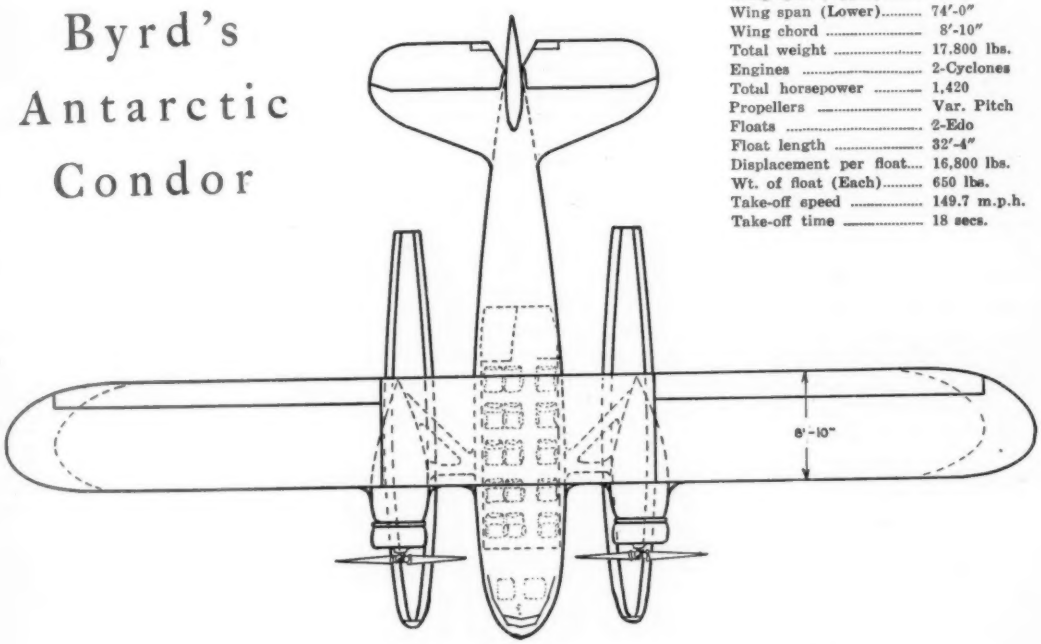
This specially adapted Curtiss "Condor" biplane is provided with Edo floats which enables the ship to land or take off from either water or ice. It was built for Byrd's Second Antarctic Expedition.

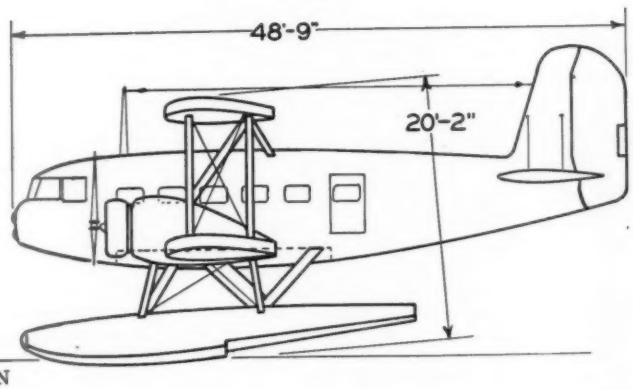


Byrd's Antarctic Condor

GENERAL NOTES

Wing span (Upper)	82'-0"
Wing span (Lower)	74'-0"
Wing chord	8'-10"
Total weight	17,800 lbs.
Engines	2-Cyclones
Total horsepower	1,420
Propellers	Var. Pitch
Floats	2-Edo
Float length	32'-4"
Displacement per float	16,800 lbs.
Wt. of float (Each)	650 lbs.
Take-off speed	149.7 m.p.h.
Take-off time	18 secs.





William E. Boeing—Prominent in Aviation

Mr. Boeing, one of the most successful aviation executives of today.

WILLIAM E. BOEING, Chairman of the United Aircraft and Transport Corporation, is one of the outstanding figures in present-day aviation. His activities extend over all branches of aviation.

The present enormous Boeing interests have sprung up within a comparatively few years from a small airplane manufacturing plant on the Pacific Coast.

I Shouldn't Wonder

"Edgar, did they get that idea from an eggbeater?"

The Aero-Sportswomen

by JOAN THOMAS

WHEN Edith Foltz, transport pilot from Portland, Oregon, took fourth place in the inventors' meet at the Century of Progress last summer with her "Folz-up suit," a combination sport suit and flying costume, she seems to have started a new profession for women flyers.

In addition to a strenuous career of lecturing, writing and flying, Amelia Earhart has turned designer—and that should be spelled with a capital D, for some thirty leading department stores scattered from coast to coast are featuring a new line of sports-wear bearing her name.

There are neat looking serviceable flying togs in Grenfell cloth, wool lined for warmth or unlined for summer wear; jaunty tweeds for sport or travel, shirts of parachute silk, airy little sweaters and even summer sport dresses, simple in design but tremendously effective. The aviation note is carried out in tricky accessories—ball-bearing belt buckles, cotter pin fasteners, zippers instead of buttons, web belts with parachute clasps and metal trimmings made of bolts and taps—all the gadgets familiar to the sky-ways.

Then, there are the *hats*, and that made us smile, Amelia, whose tousled mop of curls is as famous as her smile—designing hats!

And to make it even more amusing, she has started a "Hat Contest." When she started this idea it was to be in recognition of something important accomplished each month by a woman flyer. Four or five of the 99's went into "conference" and decided that landing in strange airports was good practice, so the basis for the award would be the landing in the greatest number. According to the official announcement in the 99er, scoring will run:

"For each airport, 1 point; for an honest to goodness forced landing without damage (verified by Department of Commerce inspector), 2 points; if cows in pasture, 3 points. (If cows eat fabric before rescued, damage not counted as resulting from crackup.)"

The mechanics of the contest as drawn up by Amelia are: 1. Candidate must furnish proof of landing by having signature of airport-manager or some other responsible person to verify the landing.

2. The report form with signatures, etc., must be sent to the sectional governor not later than the last day of the month. The governor will check and select the highest ranking hat-chaser in her section within five days, sign and send her report slip to the editor of the 99'er who will get the slip belonging to the successful one countersigned by Amelia and returned to the winner. Slip in hand, the winner will then go to the nearest one of the 30 stores carrying the Amelia Earhart line and select her hat.

Marshall Field's in Chicago, one of the thirty, not only have a special Amelia Earhart shop with pretty, young mannequins appearing very aeronautical and nonchalant in charge, but also have arranged an effective display in *two* of the famous State Street windows.

Amelia Earhart, now turned designer of sports-wear, displays her latest creation.

* * *

WE don't very often allow ourselves the uncertain pleasure of envying anyone. If someone flies the Atlantic, we remember vivid tales of nerve-racking hours when there was neither sea nor sky, and the little white lights on the instrument board were small comfort; if other people make endurance flights, we console ourselves by remembering that Francis and Helen pumped 8 tons, or 2,667 gallons of gas in their nine days plus! When a new altitude record is made in France, we don't worry because we've been told that none of our ships *could* make a better mark, so why try? But when we get a cablegram from Vladivostok saying:

"Enroute Changchun for coronation Puyi thence two months' trip, important points far east expecting return Moscow via India early May. If there's anything I can do for you please inform. Will be at Imperial Hotel, Tokyo about April first. Have fun. Luck.

(Signed) FAY GILLIS."

We simply turned green with envy. Yes, green with yellow spots and purple splotches! Even the most prosaic stay-at-homer, who usually looks bored when one begins to dream of far horizons, gets all stirred up when they see that cable.

(*Concluded on page* 332)

Testing Planes for Strength

by PERCY ANDREWS

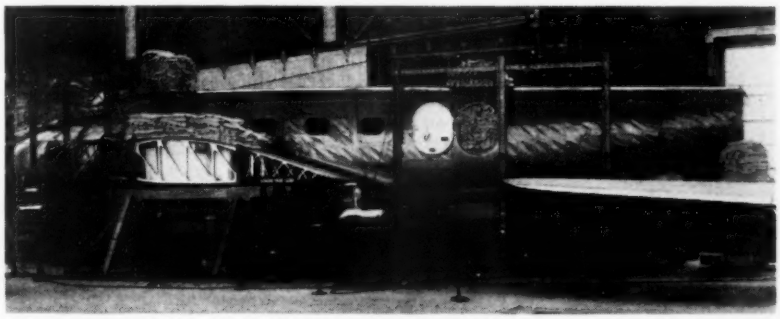
Precautions taken by airplane manufacturers to determine the strength of airplane structures for securing safely in flight. Tests in the Boeing and Lockheed plants are used as illustrations.

IN the design of an airplane, the stresses and loads are first carefully computed by the engineering department, but as a matter of fact, these computations are simply estimates based upon factors determined from previous constructions.

The only possible method of determining the stresses and the strength of the structural members is to actually load the completed plane and its components with weights corresponding to the maximum loads that will come on the various parts. And even this is not an absolutely certain test for the reasons that the loading itself is assumed and the loads are "static" or quiet loads instead of the actual varying loads of practice. The structure may either be tested to destruction, that is, by increasing the loading until it fails, or the effect of the loading may be determined by the deflection or "give" that the parts display when loaded according to standard methods.

In computing the strength, there is always a chance of overlooking heavy stresses that may occur on certain minor fittings, and as a chain is no stronger than its weakest link, the failure of this insignificant fitting may spell failure for the entire structure. To avoid the possibility of any such accident, the plane is given a "static" test by loading it with bags of sand or lead of known weight and applied at the appropriate points.

This static test, however, does not exactly reproduce the conditions met in normal flight in which the loading is "dynamic" or occurs in a series of vibrations or sudden shocks. Thus, a static test with sand bags and lead does not represent the loads due to engine vibration nor the effects of tail flutter. This means that the static loads must be multiplied by some assumed figure in order to arrive at equivalent results, and once again we have an estimated or actually unknown quantity to deal with.



Showing the method of applying test loads on the Boeing "247" transport fuselage. Fifty tons are applied in this case, an excess of 20 tons over the requirements.

The whole matter is rather uncertain and not definitely accurate, but it is the best that can be done under the circumstances. The proof of the pudding, of course, is a series of actual test flights with the machine under maximum service conditions. It is the flight tests that vindicate or fail to vindicate the stress computations and the static tests. However, the static tests clear away a certain element of the uncertainty before the test pilot risks his neck.

In this article we show two series of static tests made respectively on a transport fuselage and on the wings of a new transport plane. In the case of the Boeing "247" fuselage, the lead weights are distributed according to the corresponding loading in service, the various piles of lead representing the dead weights, the lift of the wings, the weights of the fuel, baggage and passengers and the loading on the tail group.

Load concentration on the nose of the Boeing "247" fuselage. Overloaded but no failure is indicated.

As shown, the total loading on the body is 50 tons, which is exactly 20 tons greater than that required for the government license. The license in turn calls for a stress resistance several times greater than the actual computed load, so that the test load shown in the photos is undoubtedly far higher than any requirement in flight.

In the case of the test on the wings of the Lockheed "Electra" transport, 13 tons of lead and sand were piled up on the under surface of the wings to represent the lift of the wings and the air pressure. The wings during this test were attached to the fuselage so that this really corresponds to a test

A static test made by loading the wing of a Lockheed "Electra" with 13-tons of lead and sand. The deflection was only 5-inches.

of the completed plane. In addition, 10,000 pounds of lead were loaded on the engine mounts at the same time to represent the weight of the engines and the load due to engine torque.

Although the wing was loaded with a weight equal to four times the normal loaded weight of the airplane in flight, the extreme ends of the wing showed only a deflection of five inches, and after the load was removed, the wing returned to its normal position. To simulate the upward pressure of the air, it was necessary to place the plane on its back during the tests since the weight of the bags acted downwards instead of up. Careful examination failed to reveal a fracture or displacement of any sort so that the engineering department were vindicated in their computations by the tests.

"But," says the layman, "why not make the parts 25 or 50 times as strong as necessary so that there will be no doubt?" and in answer to this, we may say that a great excess of structural strength is often more dangerous than just sufficient strength to pull the plane through normal flying conditions. Excess strength increases the weight, as a usual thing, and this weight in turn may introduce serious problems of its own. For example, weight can often be added in building up certain structures that is not compensated for by a corresponding increase in the strength.

Again, in the case of the airplane, added weight due to excessively strong structure, loads up the engines and increases the landing speed—both dangerous factors. In this respect, conditions are different than with the structure of a building, for with the building we have no dynamic factors to consider such as flight stresses or the power of the engines, and yet a building can also be overloaded simply by excessively heavy members in its structure. Nothing is to be gained, after a certain point is reached, by foolishly adding more and more material.

In smaller machinery, vibratory tests are often made in order to determine the resistance to dynamic loads or to that arch enemy of machines—crystallization of the metal. Possibly, in the course of time, vibration tests can also be extended to the airplane, thus adding considerably to the advancement of the study of stress.

And another uncertainty that enters into strength calculations is the uncertainty or non-uniformity of commercial materials. No two bars of steel or dural are exactly alike, nor is the composition uniform even from one end to the other of the same bar. The result is, that we never know exactly what resistance will be presented to the stresses by the materials.

Steel and alloys, in particular, are subject to the phenomenon of "segregation" which means that the alloying materials may occur in patches at one point and may be entirely lacking at another. So long as this continues, calculations will be at variance with results.

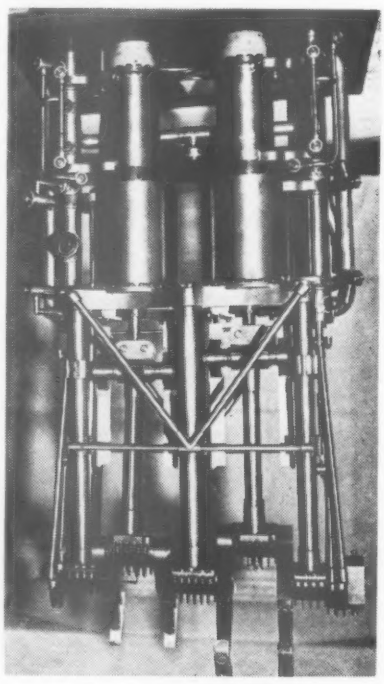
Some Early Aviation Engines

IT'S QUEER how things work out in this world. The old saw running to the effect that "the first shall be last," just about tells the whole story in a nutshell.

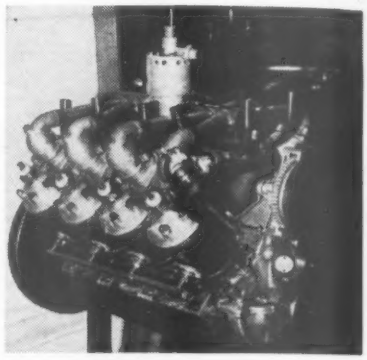
And now, when we are witnessing the attempted development of the steam-propelled airplane, we are likely to forget that the steam engine was the first motive power to be applied to the flying machines of the very early periods. First of all, we recollect the steam engine employed by Clement Ader which, by the way, was the first engine of any kind to lift a mechanically propelled plane in flight. It wasn't much of a flight, it is true, but it got the sticks and canvas off the ground and that was the first time that this was accomplished in the history of man.

Then, there were the historical experiments of Hiram Maxim, and the successful steam driven model designed and flown by Prof. Langley. The only difficulty that these old-timers encountered was the lack of the proper metals and alloys, subsequently developed by the automobile industry, which permitted lighter and stronger structures. It was rather a matter of metallurgical development that held the early birds back than details of design.

And now we have with us, a good clear picture of the old Ader steam engine which, at the present time, is reposing in a museum in France. This engine kicked Ader's "Avion" a good 500 feet in 1893 and crashed it at the end of the flight. And so, all at one time, we have the first flight and the first crash dating back more than 40 years. However, as Ader preferred to stand firmly on good old Mother Earth during this trial and view the catastrophe from afar, it was not a flight comparable with that of the Wright brothers who accompanied their invention into the air.



Clement Ader's steam airplane engine a very light and carefully designed mechanism.



An Antoinette 8-cylinder "Vee" engine used by Hubert Latham.

Ader's engine was exceedingly light. It was of the two-cylinder variety, very carefully designed and very efficient. Every little detail was considered even unto the air-cooled main bearings.

Then, in this same French museum, is another historic engine which is pictured here—the old Antoinette engine with which Hubert Latham made his valiant attempt at flying across the English Channel. This is an eight-cylinder "Vee" type engine that developed about 50 h.p. It has thin steel cylinders surrounded with electrolytically reduced copper water-jackets, and unlike modern engines, was steam-cooled instead of water-cooled. Therefore, instead of using radiators, the ship had long tubular condensers mounted along the fuselage. This engine ran surprisingly well for its time and was the forerunner of a series of "Vee-8" and "Vee-16" engines.

As a matter of fact, this engine was once built in the United States under a license, so well was it regarded at that time. It was also employed in power racing boats with great success which is not strange because the builder, M. Levasseur was also a racing boat constructor.

It was one of the first engines to employ pressure sprayed carburetion, a small gasoline pump drawing gasoline from the tank and spraying it into eight small distributers placed on the intake ports. This is a special application of the system used on the Wright engine which proved quite satisfactory. Pressure oil feed lubrication was also used throughout the engine.

Practical Lessons in Aviation

There are literally thousands of different wing sections that have been designed and tried out from time to time by the aerodynamic laboratories, and in this lesson we will investigate a few of the better known airfoils.

by JOHN B. RATHBUN

FOLLOWING the experiments of the Wright Brothers, there was an era of wing or "airfoil" development in which all sorts of arched or "cambered" wings were tried out.

These wings ranged from thin single surface curved plates to relatively thick bird-wing forms, but in the majority of cases during 1908 to 1912, the airfoils were made as thin as possible in the mistaken idea that the thin aerofoils "cut through the air" more easily and encountered less resistance.

Nearly all the wings of this time had thin sharp entering edges, reached a maximum thickness at about one-third of the chord from the leading edge, and then tapered down to a thin knife edge at the rear. Airfoil (A) in Fig. 2 is an example of this type of wing.

About this time it was found that the depth of the camber had a great deal to do with the lifting force, the lift increasing with the depth of the camber within limits. And, as might be expected, a great number of wings soon

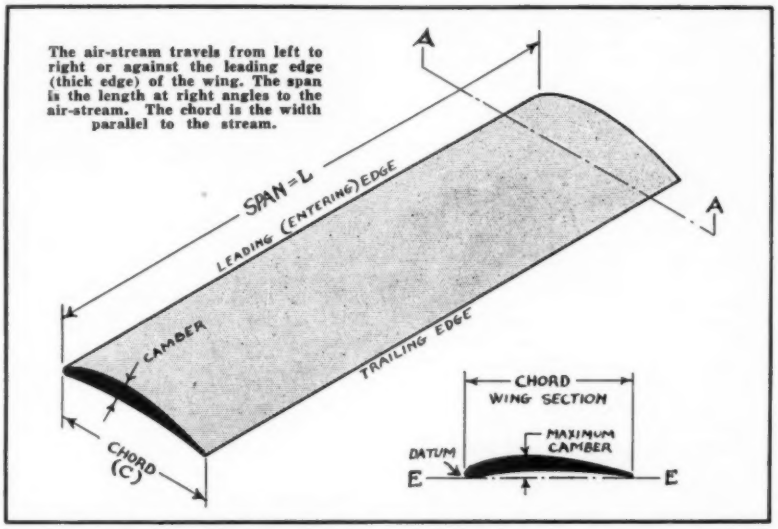

The air-stream travels from left to right or against the leading edge (thick edge) of the wing. The span is the length at right angles to the air-stream. The chord is the width parallel to the stream.
A
SPAN = L
LEADING (ENTERING) EDGE
A
CAMBER
TRAILING EDGE
CHORD (C)
CHORD
WING SECTION
MAXIMUM CAMBER
DATUM
E
E

Fig. 1. Dimensions and nomenclature of the airplane wing or airfoil. Note that a "wing section" is a view taken at the end of the wing or of a cut portion as along the line (A-A). The depth of the arched surfaces is the "camber."

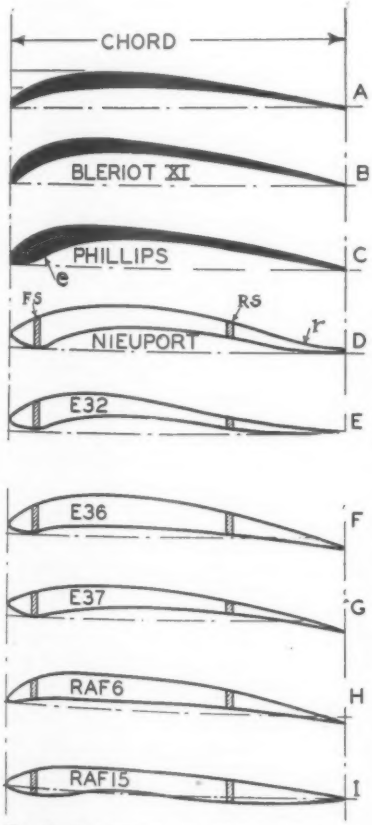


Fig. 2. Development of wing sections or airfoils.

appeared with tremendous cambers as shown by Airfoil (B). Because of their hooked appearance, they were often called "Sky-hooks" and the wing section of the Bleriot XI, 1909 monoplane was of the type shown at (B).

But, in the meantime, an Englishman by the name of Phillips had been experimenting with bird wings with the idea of getting greater thickness and hence more room for deep beams and other structural members within the wings. The thin wings and sky-hooks could only accommodate such small beams that a great amount of external bracing was necessary, and this bracing in turn, created a considerable amount of parasitic resistance. Bird wings, Phillips believed, would be far more efficient than wings of simple geometric form.

The result of his labors led to the development of the Airfoil (C) with its tremendously thick entering edge, the latter being known as "Phillip's Entry." The characteristic Phillip's Entry is indicated at (e) where there is ample room for a thick front beam, but at the rear there is hardly any improvement. The surprising thing, however, was the fact that this blunt entry showed loss resistance than many of the former sharp-nosed sections, and this discovery changed the whole trend of wing design. From 1910 on, wings of all types had blunt entries.

About the first airplane builder to avail himself of the new discovery was Nieuport, a French constructor, who

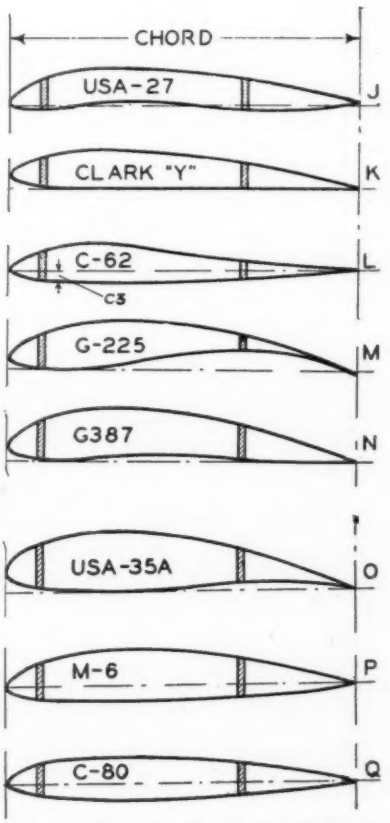


Fig. 3. Modern wing sections or airfoils now in use.

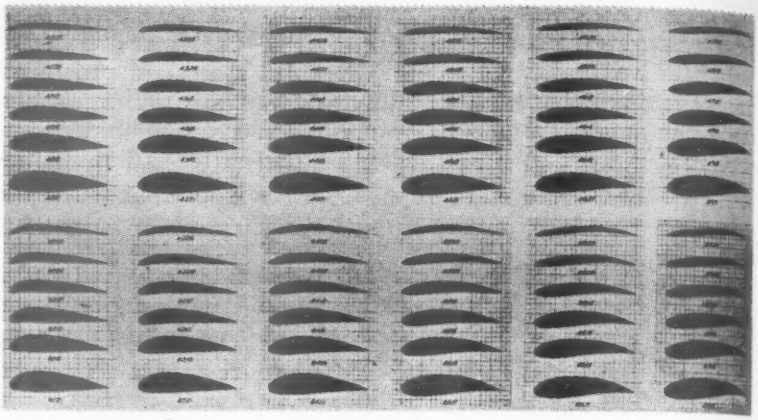
applied the principle to the wings of his little Nieuport monoplane as at (D). While Nieuport employed the new entry, he went a step farther and maintained a considerable thickness well to the rear of the wing, giving excellent depth for both the front spar at (FS) and at the rear spar (RS). The latter necessitated a reversed curvature or "reflex curve" near the rear as indicated at (r), but this was found to materially improve the stability without much affecting the efficiency of the wing. For a distance, the top and bottom surfaces are nearly parallel.

The Nieuport monoplane (1910-1911) was an excellent flying little ship for its time and developed about 50 m.p.h., with a 12 h.p., Dutheil-Chalmers 2-cylinder opposed type engine. It was one of the first ships with a really respectable rear spar, and this little monoplane is further celebrated for the fact that it was equipped with a really streamlined fuselage.

Gustave Eiffel, in his Paris aerodynamic laboratory, developed a number of highly efficient wing sections or airfoils, designed along these general lines. The Eiffel No. 32 and No. 36 were probably the best known of these series. Eiffel No. 32, which is shown by (E), gave good lift-drag ratio and was very stable, but was too thin at the rear for a good beam or spar. Its stability is due to the prolonged reflex curve at the rear.

Eiffel No. 36 shown at (F) is the first airfoil resembling a truly modern wing section and has nothing about it to suggest the sky-hook. Its lower surface has only a slight but a continuous camber, while the top surface is deeply cambered without reflex curvature in the rear. It therefore accommodates deep spars both at the front and back, while at the same time, its aerodynamic performance is very good.

Its lift value is fairly high but it is not as efficient as No. 32. The most efficient wing, so far as the ratio of lift and drag are concerned, is the Eiffel No. 37 of this same period, which has the surprisingly high L/D 20.4 against 14.3 for No. 36, or 18.2 for No. 32. This airfoil is shown at (G) where it will be seen that it is not very good from a structural point.



Twelve "families" or groups of related airfoils developed by the Advisory Committee on Aeronautics. Each group progresses from the thinnest airfoil at the top to the thickest section at the bottom of each group.

About the year 1912, the English National Physical Laboratory introduced a number of practical wing-sections or airfoils that had a great influence on airplane design. In this "R.A.F." series of airfoils was the celebrated R.A.F.6, which was more or less a standard for comparison before and during the war. The R.A.F.6 airfoil was tried out in almost every conceivable form, as a monoplane, biplane, triplane, etc., and many of present day aeronautical practices date back to this historic old wing.

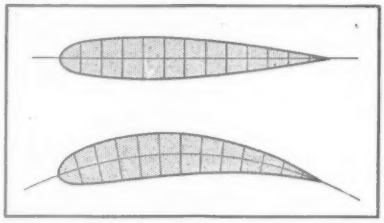


Fig. 4. Relation between a streamline body and the same body bent into the form of an unsymmetrical lifting airfoil.

The R.A.F.6 has a nearly flat under camber, as at (H). The upper surface rises sharply at the leading edge, is practically flat about one-third of the chord, and then tapers down at the rear with a short reflex curve. It has a comparatively high lift but is not remarkable for its efficiency as it has a lift-drag ratio of only 14.6. It is, however, thick enough to accommodate deep spars and is an example of what is known as a fair "all-round-wing" for an average plane of that time. There were many other airfoils in this early R.A.F. series but not distinctive enough to mention here.

After the end of the first year of the war, 1915, another very interesting airfoil was developed in England which was known as the R.A.F.15. It had a high efficiency, was fairly stable and provided room for good strong spars. The lift-drag ratio was just short of 22.0 and the section, though now 19 years old, is still used to some extent. It will be noted at (I) that the lower surface has a peculiar form, dropping below the datum line at the nose, then up to the datum line and down again at the rear and finally rising to the line at the trailing edge.

During the war, from 1915 to 1918, a great many American sections were developed, this series being known as the U.S.A. sections. There were many good airfoils in the American developments having fairly high efficiency and other meritorious points. These wartime sections were the U.S.A. 1, 2, 3, 4, 5, 6, and will not be further described at this point since the later U.S.A. airfoils are far more important.

Among the later U.S.A. airfoils of historic interest, are the U.S.A. 27 and the Clark "Y" brought out about the year 1919. These airfoils are shown here, the U.S.A. 27 at (J) and the Clark "Y" by (K). They are very efficient, have excellent structural qualities and are fairly stable examples of "all-round-wings."

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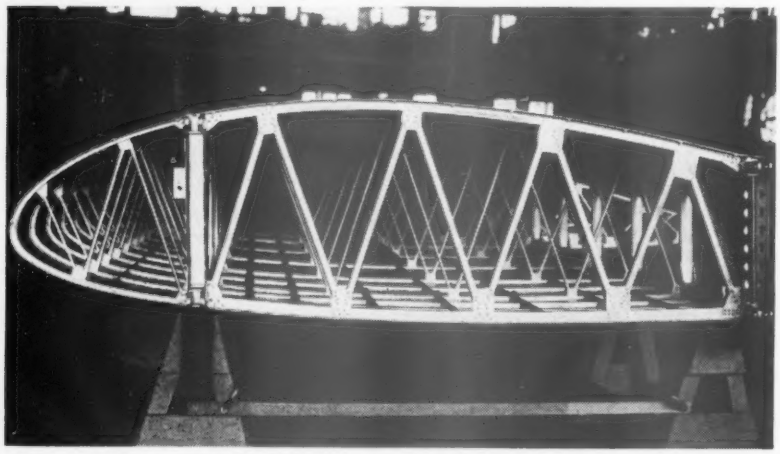


A built-up thick wing-section as employed for the cantilever wing of the Boeing "247" low-wing transport ship. In this case, many spars are employed, trussed by the diagonal members shown.

Engineer Lands Job in Mexico

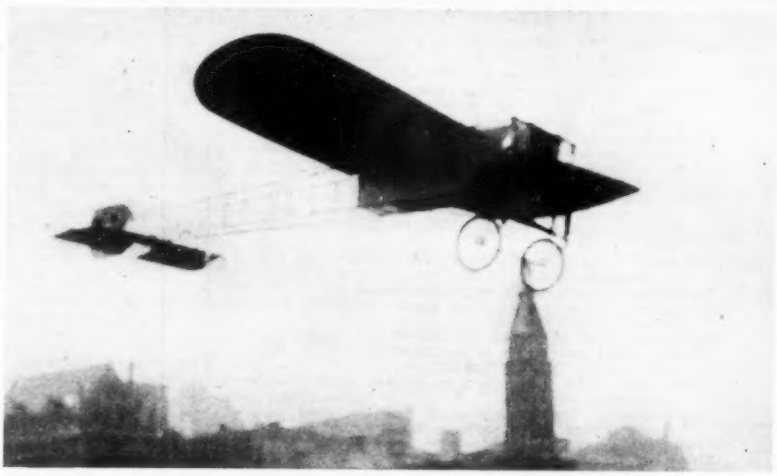
AN AIRPLANE was largely instrumental in landing a big river control construction job in Mexico.

H. B. Thompson, chief engineer for the construction company, took by plane from Lincoln immediately after an invitation to study the project had been extended by the United Sugar Company, Las Mochis, Sonora.

Rio del Fuerte, the large river on which the company's sugar plants are located, was on a rampage with floods threatening to do serious damage to the plants. Mr. Thompson also found that the river, which is inclined to change its channel during flood times after the fashion of the Missouri river in this country and on which his company has done millions of dollars worth of control and protection work, was about to cut off the water supply of a city of 9,000 inhabitants.

Thompson studied the situation and drew up a channel improvement plan on the same principles as the Woods company is employing on the Mississippi, Missouri and Ohio rivers at the present time. The Mexican company approved the plans of the American engineer and his company got the job. He was back at his Lincoln headquarters with the signed contract in about the same elapsed time that would have been required to reach Las Mochis by any other means of transportation.

Do You Remember This Old Bird?



The old Bleriot goes sailing along, not as fast as a pursuit ship, but fast enough to throw a thrill into the 1912 vintage spectator. It was a very graceful flyer.

THIS picture of a Bleriot XI Cross-Channel monoplane was taken at the First International Aeroplane Races held in Chicago in 1912. It was flown by St. Croix Johnston over Grant Park on the lake-front as will be seen from the tall buildings in the background.

Before the end of this meet, the plane started on a long glide that ended disastrously in Lake Michigan, very close to the point where this picture was taken. As was afterwards discovered, after an examination by physicians, Johnston was dead before he struck the water having evidently succumbed to a heart attack, while in flight. The plane was not damaged.

PARASITIC RESISTANCE—AER-R-60

NOTE! In the following table, the resistance of various airplane parts in pounds and at a speed of 100 m.p.h. is given. These are average representative values but are subject to some variation due to size, design, etc. Standard air is assumed.

	Lbs. Drag
Flat Plate, 1 ft. square	32.8
Standard Wheels, faired—	
Low press. Tire wheel, 22x10	9.50
26x3	7.50
28x4	10.00
30x5	12.50
32x6	16.00
36x8	24.00
44x10	36.60
54x12	54.00
Air-cooled engines, per cylinder—	
No ring nor cowl	8.50
N.A.C.A. cowl	5.20
Fuselage—	
Square section, per sq. ft. sectional area	7.20
Round or elliptical section, per sq. ft.	4.60
Streamline form with no openings	3.80
Nacelles—	
Fairly well streamlined, per sq. ft.	6.30
Engine type, single engine, per sq. ft.	7.80
Engine type, two engines, per sq. ft.	8.20
Radiators—	
Nose type, per sq. ft. presented area	17.50
Lamblin type, per sq. ft. presented area	10.50
Landing gear, per sq. ft. of fuselage section	3.50
Stranded Stay Wire, $\frac{1}{32}$" dia., per foot of length	0.48
Streamline wire, 0.087 in., per foot of length	0.074
Struts, U. S. Navy No. 1 Type—	
1.0" thick, per foot	1.300
1.5" thick, per foot	2.500
2.0" thick, per foot	3.250
2.5" thick, per foot	4.000
3.0" thick, per foot	4.750
Strut fittings, sockets, etc. (both ends)	3.600
Cable fittings (turnbuckle plus eye)	0.960
Control horn, well streamlined	1.000
Tail-skid	3.000
Seaplane floats, per sq. ft. sectional area	6.000
Boat hulls, good form, per sq. ft. sectional area	5.000
Wing tip floats, per float	6.000

POPULAR AVIATION, 1934 AER-R-60

BAROMETRIC FORECASTS—MET-F-52

ALTITUDES OF CITIES. As a means of checking up on the altitudes at various localities in making corrections on the barometer, the following list of American Cities and their altitudes are given. All elevations are above sea-level in feet, most of them being taken at the local Weather Bureau.

Abilene, Texas	1,738	Memphis, Tenn.	397
Akron, Ohio	873	Milwaukee, Wis.	681
Atlanta, Georgia	1,174	Minneapolis, Minn.	837
Bakersfield, Calif.	420	Muskogee, Okla.	611
Baltimore, Md.	123	Nashville, Tenn.	546
Bismark, N. Dak.	1,764	Ogden, Utah	4,307
Boise, Idaho	2,739	Oil City, Pa.	1,045
Boston, Mass.	125	Oklahoma City, Okla.	1,214
Bowling Green, Ky.	469	Omaha, Nebr.	1,123
Buffalo, N. Y.	576	Philadelphia, Pa.	117
Charlotte, N. C.	773	Phoenix, Ariz.	1,108
Chattanooga, Tenn.	674	Pierre, S. Dak.	1,512
Cheyenne, Wyo.	6,088	Pittsburgh, Pa.	697
Chicago, Ill.	823	Port Huron, Mich.	600
Cincinnati, Ohio	628	Pueblo, Colo.	4,685
Cleveland, Ohio	762	Ranger, Tex.	1,429
Colorado Springs, Colo.	6,072	Richmond, Va.	144
Council Bluffs, Ia.	990	Rochester, N. Y.	510
Davenport, Ia.	606	St. Joseph, Mo.	850
Denver, Colo.	5,291	St. Louis, Mo.	567
Detroit, Mich.	730	Salt Lake City, Utah	4,366
Duluth, Minn.	702	San Antonio, Tex.	701
El Dorado, Kans.	1,284	Sandusky, Ohio	629
Erie, Pa.	713	San Francisco, Calif.	155
Fort Worth, Texas	670	Sioux City, Ia.	1,135
Indianapolis, Ind.	822	Spokane, Wash.	1,943
Joplin, Mo.	1,014	Syracuse, N. Y.	398
Kansas City, Mo.	963	Tucson, Ariz.	2,389
Knoxville, Tenn.	1,004	Tulsa, Okla.	711
LaCrosse, Wis.	714	Utica, N. Y.	407
Lansing, Mich.	881	Vicksburg, Miss.	247
Lexington, Ky.	989	Warren, Pa.	1,137
Lincoln, Neb.	1,189	Washington, D. C.	112
Little Rock, Ark.	357	Wichita, Kans.	1,358
Los Angeles, Calif.	338	Worcester, Mass.	514
Louisville, Ky.	525	Youngstown, Ohio	863

This data is also useful in planning cross-country hops where elevations may seriously influence take-off.

POPULAR AVIATION, 1934 MET-F-52

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-11

Air-Dilution. The contamination of a balloon or airship gas by the entrance of air. It is expressed as the percentage of purity of the gas.

Air-Disc. (1) The cross-sectional area of a circular air-stream. (2) The circular area swept out by revolving propeller blades.

Air-Displacement. The volume or weight of air displaced or occupied by a balloon or dirigible. The weight of air displaced, less the weight of the gas and ship, gives the net lifting capacity.

Air-Distance. The distance travelled through the air in miles without respect to the earth. It is the AIR-SPEED multiplied by the FUEL-HOURS or hours of flight.

Airdrome. A port or a field, with suitable buildings, for the operation, landing, storage and repair of aircraft.

Air-Engine. An engine driven by compressed air.

Air Eddies. Whirling rotating masses of air. Also known as TURBULENCE.

Air-Entry. Form of forward portion of body or method of entering still air by a moving object. Thus, the entry may be "blunt," "sharp," etc.

Air-Envelope. The atmosphere or blanket of air surrounding the earth.

Air-Expansion. The application of heat increases the volume of free air or expands it. Expansion is an increase of volume.

Air-Flow. The movement of a body of air. Its velocity is measurable in feet per second or per minute. The volume of flow is measured in cubic feet per minute or per second.

Airfoil. An airplane wing or lifting surface having curved or arched top or bottom surfaces. The curvature or "camber" can be seen from the ends or a section.

Airfoil Area. In calculations, the "projected area of an airfoil is employed. This is equal to the airfoil length multiplied by its average width. Usually given in square feet or square meters.

Airfoil Burble Point. The high angle of an airfoil made with the air-stream at which the lift drops off due to the air-stream breaking away from the upper surface. This occurs just after the angle of maximum lift and will average from 12 to 16 degrees.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-12

Airfoil Camber. The maximum depth or height of curvature of an airfoil measured above a straight datum line called the CHORD.

Airfoil Center of Pressure (C.P.). (1) The point at which all of the air pressures on an airfoil can be considered as acting collectively. (2) The point at which the airfoil will balance at a given ANGLE OF ATTACK. On most airfoils, the C.P. moves forward with an increasing angle of attack, but in some cases the movement is negligible.

Airfoil Chord. (1) A straight datum or reference line touching the two points furthest apart on an airfoil section, or connecting the two extreme outer points at the leading end trailing edges. (2) The width of an airfoil measured in the direction of the air-stream.

Airfoil Coefficient. A quantity, determined by test, which represents the lift or drag of a given airfoil form per unit of area, per unit of speed. This varies with each angle of attack. There are two series of coefficients in use in this country. The ENGINEERING SYSTEM with the velocity in miles per hour and the N.A.C.A. ABSOLUTE SYSTEMS based upon absolute units.

Airfoil Drag. The horizontal force in pounds tending to carry the airfoil along with the air-stream. This must be overcome by the thrust of the propeller in flight. Formerly called the "drift."

Airfoil Efficiency. While the effectiveness of a given airfoil is not given in dimensions of efficiency, its effectiveness is given as the ratio of its lifting ability (L) to the drag (D). This is the LIFT-DRAG RATIO or L/D.

Airfoil Lift. The vertical lifting force produced in pounds by an airfoil in the wind-stream.

Airfoil Section. A particular type of airfoil classified according to the nature of the curvature on the top and bottom surfaces as seen from an end view or cross-section. See AIRFOIL.

Air Friction. A retarding force due to the rubbing of an air-stream on a surface. The friction reduces the velocity of the air-stream near the surface.

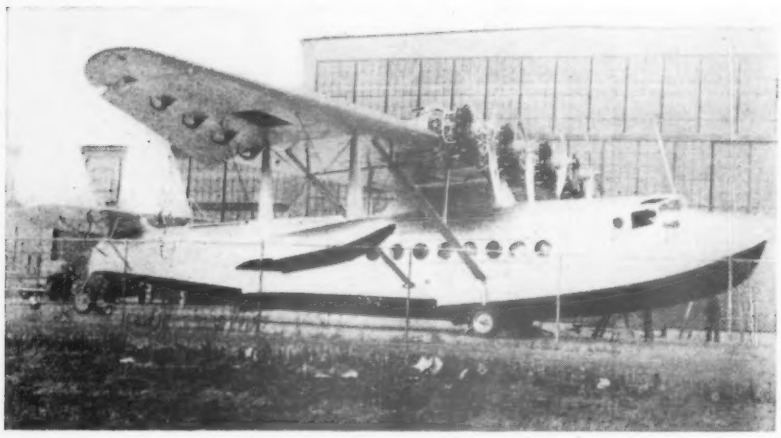
Air-Gap. (1) The distance between the electrodes in a spark plug, is the air-gap or the length of the spark. (2) An air space between two surfaces.

Views of the Pan-American Sikorsky

THE Sikorsky giant flying boat, built for the Pan-American Airways, is shown while being made ready for its first flight. It has been under construction, closely guarded, for the past 18 months at the Sikorsky factory, Bridgeport, Conn., and it is said that it is intended for use in transatlantic service.

This huge flying boat, known as the Sikorsky S-42, has a seating capacity for 32 passengers, a crew of five men and will carry half a ton of mail when fueled for a 1,200 mile flight. It is of the high-wing monoplane type with four engine nacelles faired into the wing. The cruising speed is said to be 150 m.p.h. The engines total 3,000 h.p.

The hull is of unsually robust construction, well adapted for oceanic service and, as will be seen, is provided with two steps.



Side elevation of the Pan-American Sikorsky flying boat S-42 showing the two steps in the hull and the arrangement of the engines.

Yes — Cows Fly

THE Boeing Airplane Company admits that cows, taken as a whole, don't fly, but they do claim that the basic elements of the cow are often encountered whizzing about in aviation. And here is what they say about it:

1. Casein, an element of milk, makes the strongest kind of waterproof glue used in airplane construction.
2. Blood is used for albumin glue.
3. Bones and hoofs are the source of hot glues.
4. Hair is used for sound-proof insulation and padding.
5. Hides are used for seat coverings, straps, etc.
6. Caecum or "goldbeater's skin is used in the gas bag construction of airships.

Bellanca Dimensions

OWING to difficulties experienced in scaling the dimensions from the factory blueprint, we wish to call your attention to a correction to the drawing of the Bellanca shown in the April issue. The tread, or distance between the wheels should be 18 ft. 0 in. instead of 22 ft. 0 in.

The builders inform us that their latest specification with a 715 h.p. Wright "Cyclone" engine shows a top speed of 165 m.p.h. and a cruising speed of 145 m.p.h. The rate of climb is said to be 700 feet per minute.

An Aviation Engine Quiz

Compiled by P. A. Technical Staff

This series of aviation engine articles, arranged in "catechism" form, will include all of the subjects covered by the Department of Commerce examinations and the Army Air Corps Technical School.

Q. To what general class of prime movers does the aviation engine belong?
A. To the heat engine division.

Q. What are heat engines?
A. They are machines employed for converting heat or "calorific" energy into mechanical energy or force and motion.

Q. How is the heat energy produced?
A. By burning a carbon bearing substance known as a "fuel." This process, also known as "combustion," consists of a chemical combination of the oxygen of the air with the fuel.

Q. How is this heat energy measured?
A. In terms of the British termal unit (B.t.u.). This is the quantity of heat required to raise one pound of water by 1°F. In the metric system, heat energy or quantity is indicated by the "calorie" which will be explained later.

Q. What is the name of the instrument used for measuring heat energy or quantity?
A. It is called a "Calorimeter."

Q. How much heat do fuels contain?
A. The calorific content of coal is from 9,000 to 14,500 B.t.u. per pound; kerosine contains about 18,000 B.t.u. per pound, and high grade gasoline about 21,000 B.t.u. per pound.

Q. Gasoline apparently contains a tremendous amount of heat per pound of weight?
A. Yes. It is the most compact fuel known and is therefore best adapted to the aviation engine.

Q. Can these liquid fuels: gasoline, kerosene or fuel oil be burned directly?
A. No. They must first be vaporized or converted into a vapor. This vapor is then mixed with the proper amount of air (or oxygen) to burn it.

Q. Are the fuels always completely burned so that all of their energy is converted into heat energy?
A. No. There are losses due to incomplete mixtures of vapor and air, and to incorrect proportions of the vapor to the air.

Q. Can heat energy be converted into terms of mechanical power? In other words, how can we calculate the amount of power that can be obtained from a B.t.u.?
A. One B.t.u. of heat energy is equal to 778 foot-pounds of mechanical energy.

Q. What is the equivalent of a B.t.u. in terms of horsepower?
A. A mechanical horsepower is equal to the expenditure of 33,000 foot-pounds per minute, hence if we supply heat at the rate of one B.t.u. per minute, this will be 0.0236 h.p. if the conversion takes place without loss.

Q. Are the heat losses extensive when the fuel is burned in the engine?
A. Yes. From 70 to 75 percent. of the energy in the fuel is lost in various ways so that we can only expect a useful return of from 25 to 30 percent. of the fuel value.

Q. How much gasoline is consumed per horsepower?
A. The fuel consumption must be given in terms of horsepower-hours, not horsepower, because time enters into this problem. The gasoline onsumption will range from 0.45 to 0.65 pound of gasoline per horsepower-hour, depending upon the type of engine and its condition. A fair average is 0.55 pound per h.p. hour.

Q. How much does gasoline weigh?
A. The weights will range from 5.5 to 7.5 pounds per gallon.

Q. What is the composition of the liquid fuels ordinarily used in the aviation engine?
A. The common fuels such as gasoline, kerosene or fuel oil, belong chemically to the hydrocarbons, that is, they consist of hydrogen gas combined with carbon in various proportions.

WHILE aviation engines operate on the same general principles as automobile engines, yet they differ greatly in detail and in the matter of repair and adjustment.

Therefore, a specialized treatise, such as the present course, treating exclusively of aviation engines is necessary for a complete understanding of airplane power plants.

Q. What happens when these hydrocarbon fuels are completely burned?
A. The oxygen of the air combines with the carbon of the liquid and produces carbon dioxide gas. The oxygen also combines with the hydrogen and forms water vapor.

Q. If the combustion is never complete, as you have previously stated, what is the reaction then?
A. Some of the fuel is chemically decomposed instead of being burned. The resulting gases, known as the "products of combustion" are: Carbon dioxide, carbon monoxide, free hydrogen, free carbon (soot), methane, acetylene, water vapor, etc.

Q. Is there a name for the combustible mixture of air and gasoline vapor?
A. Yes. It is called the "mixture" and sometimes "carbureted air." The carbureter is, therefore, a device for adding carbon to the air taken by the engine.

Q. Does each pound of gasoline require a definite amount of air to burn it?
A. A definite minimum amount of air is required for the complete combustion of a given gasoline, but the gasoline will also burn throughout a rather wide range of proportions with excess air.

Q. How many kinds of heat engines are used?
A. They are divided into two general classes: (1) The external combustion engine of which the steam engine is an example, and (2) The internal combustion engine which is most commonly used for airplane and automobile propulsion.

Q. Describe an external combustion engine.
A. The fuel is burned in a boiler, the heat of the fuel being employed to convert water into steam and thus to produce a pressure. The steam, and with it the heat, is then led to the engine proper where the heat is converted into mechanical power.

Q. Describe an internal combustion engine.
A. The fuel is burned directly within the working cylinder of an internal combustion engine, all of the heat being available for expanding the air and creating pressure against the heat of the movable piston.

Q. Is the steam engine as efficient as an internal combustion engine?
A. In the large sizes, employed by factories and central lighting plants, where high steam pressures are used and where the exhaust steam is condensed, the efficiency of the steam engine or steam turbine is considerably higher than the average aviation engine, but with low pressure low-temperature steam, the internal combustion engine is the superior.

Q. Is it possible, then, that steam engines can be used for aviation in competition with internal combustion engines?
A. Yes. With steam pressures of about 1,000 pounds per square inch and condensing the exhaust, the efficiency of the steam engine would be equal to or superior to present gasoline engines.

Q. This is hard to believe. I have always read that the steam engine was very inefficient and that the gasoline engine and Diesel engine are very efficient.
A. That was the case, years ago, when low steam pressures were common, but today it is different. For example, if the steam temperature is 600°F., with 150°F. superheat, and the

(Concluded on page 336)

Lightplane Construction Hints

by F. E. NAGLE

The author gives many valuable instructions for the home-builder on the construction of the various items entering into the construction of a lightplane.

WHEN using a straight axle type of gear, be sure you use a spreader tube of sufficient diameter to prevent bending. Sufficient shock cord should be wrapped around the axle to prevent any "give" when the ship is at rest. Shock cord, when used for this purpose, should be wrapped as tightly as possible and the ends are tied firmly with linen cord, shellacked and taped. For split type gear, rubber discs, shock cord and various hydraulic struts have been used. A few ships have made use of coil springs. For the average builder, shock cord will undoubtedly be best, if the expense is to be kept down.

A few of the common methods of incorporating shock absorbers with split-type landing gears are sketched. One of the most common methods is the use of telescoping tubes, the lower sliding within the upper. The upper tube is slotted a little more than the amount of play, and tubes of about one-half inch o.d. are inserted as shown in the sketch. The lower inserted tube is welded in place with gussets above, and sufficient shock cord is wrapped around the tubes so they are about four inches apart when the ship is loaded at rest. Washers should be welded at the ends of the tubes to prevent the shock cord from slipping off. The method of using rubber compression discs is also shown. For the average home builder, hydraulic struts will be out of the question, but the principle is illustrated for those who may wish to use them. Generally, a light oil is used for fluid, something about the consistency of "Three - In - One," or slightly heavier.

Care should also be taken in making up landing-gear fittings in regard to strength and proper design. It pays to use some sort of universal fitting if there is any chance of eccentric action occurring. If you intend to do a lot of flying or use rough fields, it would be a good idea to make your fittings a little oversize and install bushings made of small diameter steel tube. Then, when excess wear is noticed, the old bushings can be knocked out and new bushings and bolts substituted. All such bushings should be a drive fit so there will be no possibility of their coming loose or turning.

It should be borne in mind that the only satisfactory stock to use for fittings is regular sheet steel, either low carbon or chrome moly. Sheet iron is to be left alone. Also use regular aircraft nickel-steel bolts for all bolted connections. The cost of these bolts will be a little more than that of stove or machine bolts, but they are from four to ten times as strong. They are measured from under the head to the end of the bolt when ordering, but allowance should be made for the space taken up by the nut, which in most cases will be cotter pinned. These bolts come with cotter-pin hole ready drilled and regular aircraft castle-nuts should be used with them. Plain nuts can also be obtained and these should be safetied by centerpunching the end of the bolt, at the nut. Aircraft bolts in common use range from three-sixteenths inch up, in sixteenth-inch sizes. All threads are S.A.E.

The complete lightplane, for successful flight or safety, requires the greatest possible amount of care and thought in its construction.

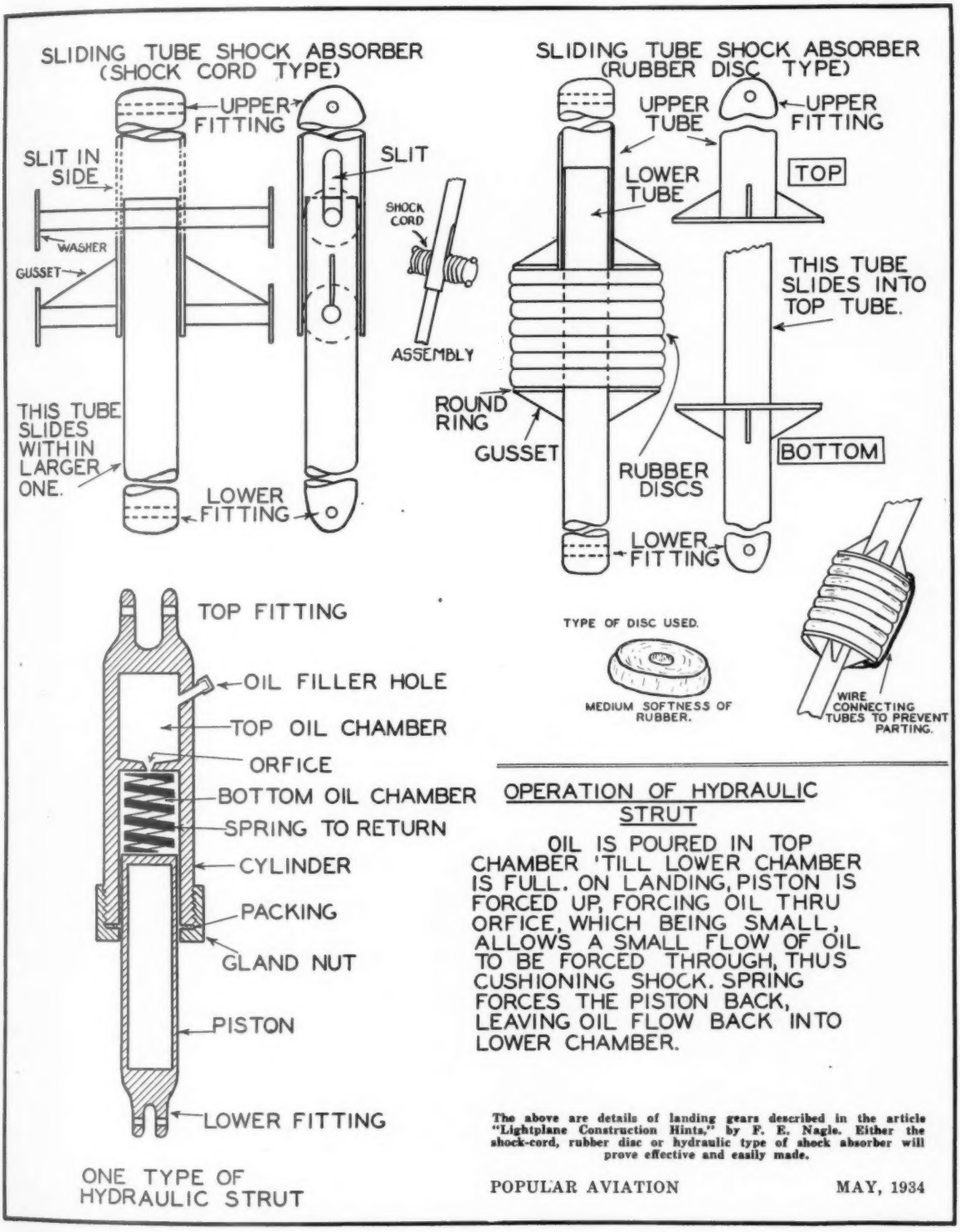
In designing the motor - mount for your ship, it will pay to make use of a removable one. This can be accomplished by having the mount bolt to the fuselage at the forward bay. The type of mount used will depend on the motor employed. For an in-line motor, it is general practice to use two hardwood rails to which the motor is bolted, the rails or motor bed being fastened to the fuselage by tubing members. Some opposed motors make use of the same scheme, but common practice favors the use of a mounting plate welded to members running to the fuselage fittings. In some cases a plywood plate, about three-quarters inch thick, has been used for a mounting plate on both opposed and radial motors. This absorbs some of the vibration and helps greatly in preventing cracked fittings. As a general rule, radial motors employ tubing ring with fittings attached, for the motor bolts, which is in turn attached to the fuselage by tubing members. It is desirable to use hard fibre or canvas washers between the motor and mount and, needless to say, they should all be of the same thickness. They help stop vibration from being transmitted to the frame. All bolts should be nickel-steel aircraft. Various types of motor-mounts are shown, and these sketches can be followed in building your mount.

After the fuselage, landing gear and motor-mount have been built up, it is a good plan to install all the furnishings, such as floors, seats, controls, instruments, etc. Plywood of one - quarter inch thickness is generally used for flooring the cockpit and should be fastened down firmly, with reinforcements glued beneath, if it tends to bow when stood on. Seats in most cases are made of aluminum sheet, eighteen gauge half-hard with turned edges, to prevent cut hands, etc. The control system will, of course, depend on the ship, but provisions should be made in its installation for the comfort of the occupant. In most ships, the stick is placed about two feet from the seat back and the rudder pedals or bar about three and one-half feet from the seat back. Of course, these dimensions will have to be changed if unsuited to the builder of the ship. Be sure that both stick and pedals have ample play in all directions. For control cables, use regular aircraft cable and none other. This comes in three kinds, non-flexible, flexible and extra-flexible. Non-flex should only be used for brace wires, etc., and not for control cables. Flexible, 7x7 strand, should be used when the cables don't run through pulleys but work on a straight course. Extra flexible, 7x19 strand, is used for all cables that run through pulleys, or do not work on a straight course. The first number in the cable designation indicates the number of stands, and the second, the number of wires in each strand. All wires should have turnbuckles on one end for adjustment and be sure to use the proper size thimble when making up the ends. The ends may be either wrapped and soldered, or in the case of extra-flexible, spliced, using the five-

(*Concluded on page* 330)

Details of the Landing-Gear

Accompanying the article on the opposite page, are the landing-gear constructional detail sketches below. These methods will produce effective yet simple shock absorption.



The above are details of landing gears described in the article "Lightplane Construction Hints," by F. E. Nagle. Either the shock-cord, rubber disc or hydraulic type of shock absorber will prove effective and easily made.

Wing Loading vs. Landing Speed

TIREY K. VICKERS

The relation between the wing loading and the landing-speed is an important one and is clearly explained by the following article and the accompanying graph.

THE landing or stalling speed is one of the most important items in the general performance of an airplane. The advantages of a slow-landing airplane are quite evident; the ship is not only easier to land, but it will not roll as far on the ground after landing. The takeoff run will also be short as the plane will not have to accumulate as much speed before again taking the air.

In order to make the landing speed appear as low as possible, many airplane manufacturers have a habit of subtracting anywhere from 10 to 15 miles an hour from the actual landing speed before giving out their performance figures. A recent check up on 40 different American sport and training planes showed that only six had been advertised with their correct landing speeds.

The actual landing speed (in still air) of any airplane can be calculated from the equation:

$$\text{Landing speed} = \sqrt{\frac{\text{wing loading}}{\text{maximum lift coefficient}}}$$

The "Wing loading" is a quantity found by dividing the weight of the airplane, in pounds, by the wing area in square feet.

Recent data from the Compressed Air Tunnel of the National Advisory Committee for Aeronautics indicates that the maximum lift coefficients of practically all airfoils (without slots or flaps) lie very close to the value .0034. Assuming this quantity to be a constant, we can then develop a formula for landing speed that will be applicable to practically any airplane.

Our equation then looks like this:

$$\text{Landing speed} = \sqrt{\frac{\text{wing-loading}}{.0034}}$$

Now, dividing by the number .0034 is quite inconvenient, so we will attempt to simplify things. The reciprocal of .0034 (1/.0034) is 289, so we can now write our equation all on one line, thus:

$$\text{Landing speed} = \sqrt{289 \times \text{wing-loading}}$$

But 289 is still an unhandy number to play with, so we will take its square root and remove it from under the radical sign. The square root of 289 is exactly 17, so our final equation is simply this:

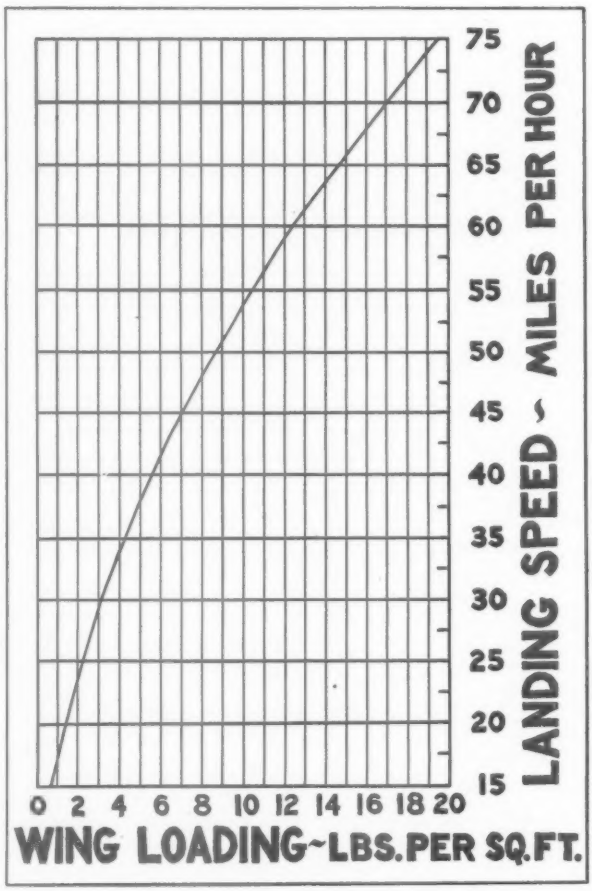
$$\text{Landing speed} = 17\sqrt{\text{wing loading}}$$

Knowing this formula, it is a simple matter to calculate the landing speed of any airplane, when the weight and wing area are known. Here's an example: A certain airplane weighs 1800 pounds and has 200 square feet of wing area. What is its landing speed?

Solution: Landing speed $= 17\sqrt{\frac{1800}{200}}$

Simplifying, we get $17\sqrt{9}$, or 17×3, which equals *51 miles per hour.*

Reproduced herewith is a graph on which different wing loadings are plotted against the corresponding values of $17\sqrt{\text{wing loading}}$. This graph can be used as a quick check on the landing speed of any conventional airplane.



To use this graph, project a vertical line from the point on the lower scale corresponding to the wing loading of the airplane until it intersects the curve. From this point of intersection project the line to the right until it intersects the vertical scale. This point on the vertical scale will correspond to the landing speed of the airplane.

Due to the following factors, this graph should not be considered an instrument of infallible accuracy. It is, however, sufficiently accurate for all practical purposes.

The fuselage on some airplanes also contributes some lift. Tests have shown that a fuselage between wings assumes as much lift as the section of the wing removed for its accommodation. This has the same effect as an increase in the wing area and results in a slight decrease in the landing speed. Before computing the landing speed of an airplane of this type, it is a good idea to add to the actual wing area, an area equal to the chord of the wing times the width of the fuselage.

A low-wing monoplane may land at a speed slightly less than an equivalent high-wing monoplane, due to "ground effect." When the wing is very close to the ground, the ground interferes with the downwash from the wing and produces an extra lifting effect. This is equivalent to an increase of the maximum lift coefficient, and enables the ship to make contact with the ground at a slower speed. This phenomenon of "ground effect" has not been thoroughly investigated as yet, but it does not decrease the landing speed of conventional low-wing monoplanes more than 4 or 5 miles per hour.

There is some uncertainty as to the exact meaning of landing speed, for some pilots can mush down at slightly lower speeds than others, hence "stalling speed" is the most accurate definition of the slow speed. However, the difference is not great at any rate and certainly not great enough to account for the difference between the actual stalling speed and the landing speeds claimed by some of the manufacturers.

END.

What Our Readers Are Building

A department devoted to our readers' activities in airplane, glider and engine construction, showing the latest developments.

All About Them

ARTHUR H. BECKER, Brocton, N. Y., has built the little Ford powered cloud-buster shown at the head of the column of pictures. It is a single place job that flies fine except that it is a little slow in climbing. This, however, Mr. Becker believes is due to the inefficient war-surplus prop that he is using. Again, the landing gear parts are not faired, and this would, of course, hold it back.

He says that the motor runs very cool when turning over at 1,400 r.p.m. and stands up against the job very well. And there is a whole lot of credit coming to Mr. Becker, for he never attended an aviation school, yet he balanced and rigged it all by himself and it was not necessary to even adjust a turnbuckle after the first flight. This is sure going some.

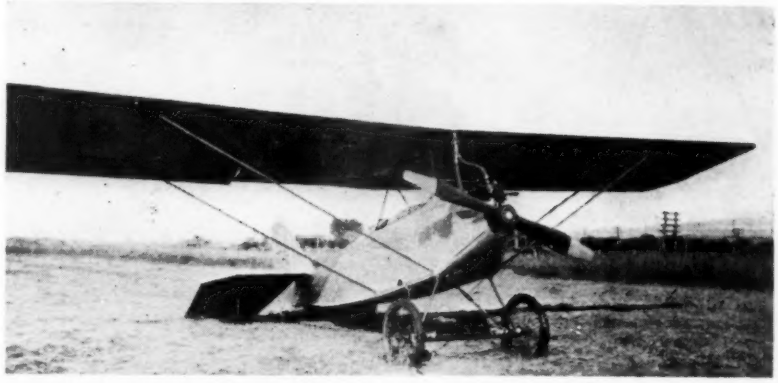
The wing span is 30'-0", length 20'-6", wing area 185 square feet and the empty weight is 525 pounds. It has a cruising speed of about 50 m.p.h. and a landing speed of about 20-25 m.p.h. All this is accomplished with a converted Model "T" Ford engine.

Milo Wittig, Green Bay, Wis., shows a snappy print of an ice-boat that he built in his spare time. He used no drawings. It is powered by a Henderson 4-cylinder engine which he converted according to his own ideas. Mr. Wittig says that he has no way of measuring the speed exactly, but that he judges this to be well above 60 m.p.h. It is certainly a neat looking affair and it would be interesting to know what would happen if stub wings were attached to the sides to reduce the weight and sliding friction according to the methods of other ice-boat builders.

Charles Dyer, Pearl St., Fitchburg, Mass., has sent the accompanying photograph of the ice-boat that he and some of his friends constructed. It is a very slick looking job made from a Pietenpol fuselage and propelled by a Chevrolet engine. He says nothing about its performance, however, but with a Chevvy engine it should be shooting around the 75 m.p.h. mark under favorable conditions.

For summer service, this little skooter is also provided with pontoons so that it can be used in water. We only hope that Mr. Dyer will give us some dope on the performance and also tell us the details of the propeller which seems to be the sticking point with many builders of ice and water-boats. We wish to apologize to Mr. Dyer for tardiness in running this picture, but there were so many entries ahead of him that had to be taken up in turn.

Just a Few Specimens of Our Readers' Work



Here's Arthur Becker's nice looking Ford "T" powered monoplane which has flown successfully from the very beginning. Its builder never attended an aviation school, yet he built, adjusted and flew, this ship without trouble.

Milo Wittig's Henderson powered ice-boat is a nifty looking affair that is full of speed yet is propelled by a small motorcycle engine. Should be a good practice ship.

Charles Dyer went them all one better with this skooter for she not only gallops over the ice but is provided with pontoons which permit her use in summer as well as winter. A nice looking ship with clean lines.

Kowalak Wins First Prize

The first prize winner, built by Floyd Kowalak, is a marvellous piece of highly detailed workmanship. It is complete down to the rivets.

ONE thing is sure: The winners of our model airplane contest, this year, certainly earned their awards by submitting the most beautiful and complete models ever entered in a contest. Mere words fail to express the beautiful workmanship displayed in the construction of the model that won first prize.

Floyd Kowalak, 240 Oneida St., Buffalo, N. Y., won the first prize by a wide margin. There was never any doubt in the minds of the judges as to which model was entitled to first place. Never was there such a wealth of detail and fine workmanship exhibited on an airplane model, for it was reproduced, inch by inch, from the large ship, metal covered with all the sheets cut to proportionate size and with even the spacing of the rivets to scale.

It is unfortunate that the accompanying photographic reproductions do not show all of the infinite detail expended upon the model, but believe us, all of the rivets, pins and small details are there, even to the propellers that look like real propellers—and this is some novelty. Mr. Kowalak says that he spent 1,000 hours on the job and we can easily believe it, for he fashioned everything by hand with the exception of some screws.

To begin the interesting part of the story, Mr. Kowalak was not satisfied with ordinary model drawings. He was out to build a super-job with more detail than any model drawing could possibly show. The only way to do this was to make his own drawings and sketches from the full size ship, and as there is no United Airline airport in Buffalo, he hopped the train for the nearest port at Cleveland, where he went to the job with a good will.

Then, after every rivet, sheet, flyspeck and spot of oil was located, he went to work in earnest. Working sheet metal is no easy job, but so carefully did he work that the metal work is without a dent, buckle or warp. The fillets between the wings and fuselage are also of metal and are perfect examples of workmanship. And you should see those engines—the most complete things that you ever looked at, with pushrods, manifolds and everything. The rudder, elevator and ailerons are movable with hinges exactly similar to those on the large ship.

On opening the door to the cabin, we see that the interior is completely equipped. The door to the baggage compartment in the nose is hinged, latched and braced properly and most of all, it swings in the right direction. The louvres in the engine nacelles, the anti-drag rings and the exhaust piping are exact replicas of the corresponding parts on the large ship. The wheels retract properly and the lights in the leading edge are in true proportion.

And now for a sketch of the winner —Floyd Kowalak himself. He is 24 years of age, and according to specifications, is no small personage, for he stands six feet one inch. In building the model, which was made expressly for this contest, he expended about thirty dollars, which also covered his trip to Cleveland. And has this boy a record for building prize winning models?

His model building career started in 1928, but has had very little experience with full size planes. He won first prize in the A. M. L. A. model contest at Buffalo in 1928, starting off as a winner in his first year. Took the eighth prize at the Detroit national contest and a second prize in a flying contest at Buffalo. In 1929, Kowalak

A closeup of Floyd Kowalak, winner of the first prize in P.A.'s model contest.

This ship won the third prize. It was built by Raymond C. Hegy who displayed unusual accuracy in its construction but who omitted much of the detail shown in the first prize winner.

in P. A.'s Model Contest

won first prize at the Buffalo Aviation Show, first prize at Jamestown Aviation Show, first prize at Buffalo A. M. L. A. contest, first prize at Buffalo Flying contest and fourth prize at the Detroit National Contest.

Mr. William B. Stout has one of his models of a Ford tri-motor made of corrugated aluminum. The Hon. James M. Mead, Washington, D. C., owns one of his models of a Fleetster. Another of his Fleetster models is on exhibition at the Institute of the Aeronautical Sciences, New York City. This is certainly a record to be proud of.

Instead of notifying Mr. Kowalak personally, he learned of his good fortune in this contest through his local paper. United Airlines sent a news release, over the Associated Press and United Press wires, to the newspapers in each town where one of the winners was located, and in this way the winners met with the surprise of their lives when they opened their paper and saw the announcement of their success staring them in the face from the printed pages.

Let Floyd tell of this in his own way, in his first letter, to us:

You can't realize how happy you have made me in awarding my model first prize in your contest. It was a surprise to me. I am highly honored and pleased to win an International contest with so many entries.

In making the air trip I would like to go to Seattle, Wash., about the middle of June. I would also like to make the trip from Buffalo to Cleveland by air, via American Airways. I hope it can be arranged and is satisfactory to you.

Meet Eugene O. Clay, winner of the second prize. He hails from the Pacific Coast.

This is the second prize winner built by Eugene O. Clay, which was noted for its fidelity to the full size ship.

1934 MODEL CONTEST WINNERS

GROUP A

Prizes in this group consist of three long trips on United Air Lines with all expenses paid, of approximately 6,000, 3,000 and 2,000 miles for the first, second and third places respectively. They will also receive gold medals as souvenirs.

1st Prize. Floyd Kowalak, 240 Oneida St., Buffalo, N. Y.
2nd Prize. Eugene O. Clay, 391 San Francisco Ave., Pomona, Calif.
3rd Prize. Raymond C. Hegy, Loyal, Wis.

GROUP B

A beautiful 20-inch silver trophy model of the Boeing "247" monoplane mounted on a pedestal. Winners in this group will also receive gold medals.

4th Prize. Albert Mueller, 28 Peach St., Buffalo, N. Y.
5th Prize. William E. Surginer, Hensley, Ark.
6th Prize. Harry Thornton, 41 Allison Ave., E. Toledo, Ohio.
7th Prize. Tom Cage, 12701 Rexwood Ave., Cleveland, Ohio.

GROUP C

Winners in this group will be granted an authorized personally conducted tour of the nearest United Air Line airport, and will also receive gold medals as souvenirs of the event.

8th Prize. Karel Valasek, 1424 Farragut Ave., Chicago, Ill.
9th Prize. Robert Willoughby, 4109 Highland, Kansas City, Mo.
10th Prize. Herman Hahn, 105 S. Eaton St., Albion, Mich.

GROUP D

The following 11 winners will receive a 3-year subscription to POPULAR AVIATION in addition to their medal.

Gordon Chain, 944 20th St., Huntington, W. Va.
William Griswold, 6413 S. Halsted St., Chicago, Ill.
Harold Hawkins, 524 Avon St., Lansing, Mich.
Woodrow Holleman, 15 Wythe St., Petersburg, Va.
Richard Hooper, 1923 N. Capitol St., Washington, D. C.
Robert J. McClug, Normandy Heights, Box 305, Norristown, N. J.
G. Warren Metcalfe, 206 Park Bank Bldg., Baltimore, Md.
Roger Norsikian, 1918 Emmet St., Omaha, Nebr.
W. P. Pinnell, 1319 Ave. L, Brooklyn, N. Y.
Glen Rymer, 1241 Jefferson St., Akron, Ohio.
Vernon Tuell, 4637 Sierra St., Riverside, Calif.

GROUP E

HONORABLE MENTION

Edward Bergstrom, 117 Bowdoin Pl., Seattle, Wash.
H. J. Brownsberger, 1491 Crestwood Rd., Toledo, Ohio.
Robert Burbick, 449 Ray St., E. Liverpool, Ohio.
Michael Doyle, 2207 Pratt St., Omaha, Nebr.
R. A. Dull, 2560 Newport Ave., Omaha, Nebr.
Sterling J. Heim, 2373 N. 66th St., Wauwatosa, Wis.
Marvin A. Krieger, 328 Ohio St., Sharon, Pa.
Edmund D. Myers, 2505 Market St., Wilmington, Del.
O. D. Payne, 2309 S. Jennings Ave., Fort Worth, Texas.
John Pogalz, 113 First Ave., N. E., N. St. Paul, Minn.

The first news that I heard was when my buddy came to my home on Sunday afternoon, Feb. 25, and asked me if I had heard anything about my model, and I said that I had heard nothing. Then he congratulated me on winning the first prize.

I didn't know how he knew about it and thought that he was kidding me—and I told him so. Then he showed me an article that he saw in the Sunday paper, the Buffalo Courier-Express. It was an Associated Press dispatch, and I had to read the article several times before I could believe it. I certainly got a big kick out of it.

Wherever I went I was congratulated by all my friends and also by people I didn't know. Major Reuben H. Fleet of the Consolidated Aircraft Corp., Buffalo, N. Y., was among the first.

I want to tell you again that I am very happy. Am also looking forward to my air-trip and visit to the Boeing factory.

But even greater news was awaiting our model champion. First, both Floyd

This is Raymond C. Hegy, third prize winner, standing by his Waco.

Kowalak and Albert Mueller, another of the Buffalo prize winners, were invited to a luncheon given in their honor by the 1,200 members of the Greater Buffalo Advertising Club at the Statler Hotel. Buffalo certainly celebrated the victory of her two boys and gave all honor and assistance to them. From what we have seen in this contest, Buffalo must be the premier airplane model town of the United States.

And, second, but not the least of the good news, is the fact that Major R. H. Fleet, president of the Consolidated Aircraft Corp., Buffalo, N. Y., has offered Kowalak a job in his plant as the direct outcome of his victory. To win a transcontinental air trip, to get a job and a whole lot of publicity and admiration are the results of one contestant's experience in the contest.

* * *

AND now we turn to the winner of the second prize. Let us introduce Eugene O. Clay, 391 San Francisco Ave., Pomona, Calif., who ran a good second to a terrific competitor. This would be better than getting first place in most any other contest.

Mr. Clay's model was also an all-metal job on which he spent more than 500 hours of labor, 175 hours of which were devoted entirely to the interior work in the cabin. It is a wonderful example of good workmanship, and runs second only for the reason that it is not quite as complete as the Kowalak ship. One outstanding feature of Mr. Clay's production is that all of the controls, including the Flettner flaps and landing-gear retracting mechanism, are operative from the pilot's compartment. Every prominent feature of the big ship is reproduced in the model which is exactly to scale in every respect.

Eugene O. Clay is stock clerk in the chemical department of Pomona College, Pomona, Calif. He has built models for five years as a hobby and has never entered any other contest. And, strange to say, he is the same height and age as the winner of the first prize. In his spare time he makes aircraft paintings and has been quite successful in this line of work. He has made aircraft paintings for the Aircraft Company, several of the Waco dealers, for the Department of Commerce Airways Division, for the March Field Officers' Club, for Richard DuPont, for the Standard and Texas Oil companies and others.

He made every part in the model including the props, engines and wheels. He has paid special attention to the interior of the cabin which is wonderfully worked out with the seats, window curtains and all of the equipment. The total cost was only $10.00, so it is obvious that Eugene carved out, hammered and sawed every individual part by himself. While he is shown standing beside the plane, he says that he is "not a licensed pilot at present." Wonder if he was grounded—or what?

Well, so long, Eugene; hope you'll enjoy your ride. Write and tell us of your experiences.

Judges of the POPULAR AVIATION-Boeing-United Airline Model Contest. Left to right: W. D. Williams, Assistant Chief Pilot of United Airlines; K. A. Kennedy, General Traffic Manager of United Airlines, and B. G. Davis, Editor of POPULAR AVIATION.

NOW we are up to the third prize winner—Raymond C. Hegy of Loyal, Wis. He is known to the Department of Commerce by another title, namely, Transport Pilot No. 3517. And here is an astonishing fact about Mr. Hegy and his model. This is the first model that he ever built and, naturally, he has never before entered a model contest. This is sure batting them off from a cold start and should add some additional marks of merit to his achievement.

He is as interesting as his model, so we'll go on with the biography a little further before starting in on his pet. He lives with an uncle on a farm and barnstorms with his faithful Waco during the summer months. He also flies a Henderson powered lightplane, of which he says he sent us a picture about a year ago but he never saw it in print. Sorry, we never got it. Please send another.

And now, after a detour, we are back to the model again, which is deserving of more prompt attention because of its excellent workmanship and well worked out details. Like the others, Mr. Hegy made all the parts himself, which is proved by the fact that the cost of all the materials was only $1.25. And beside the construction of the model itself, which was greatly admired, the contest committee particularly praise his method of packing the model in the crate. The finish was excellent, while much attention was paid to the accuracy of the major details, but, of course, the job was much more simple in wood than with the metal constructions of the first and second prize winners.

But most of the trouble that developed in getting this model into the contest was the difficulty of finding a photographer who would tackle the job during the Christmas rush. He drove 20 miles to the next city in a car without success, returned home and then warmed up the Waco and flew to Hartford, Wis. Taking the model from the plane and placing it in the rear seat of a car, he again started chasing photographers, then—"Thud" went something in the rear of the car. Looking around with a horrified gaze, he beheld his cherished model standing on its snoot with the front end all caved in! The remainder of the afternoon was spent in making repairs and on the following day the pictures were finally snapped in a pea-soup fog.

Once again we extend our felicitations, and hope that Mr. Hegy will enjoy himself with another pilot at the controls wherever he has chosen to ride.

* * *

IN fourth place is a second Buffalo, N. Y., resident—Albert Mueller of 28 Peach St., who shared the honors at luncheon with Kowalak at the Greater Buffalo Advertising Club. His model is very well worked out in detail. "Al" has been building models for about eight years and has been a winner in a local contest. He is 19 years old.

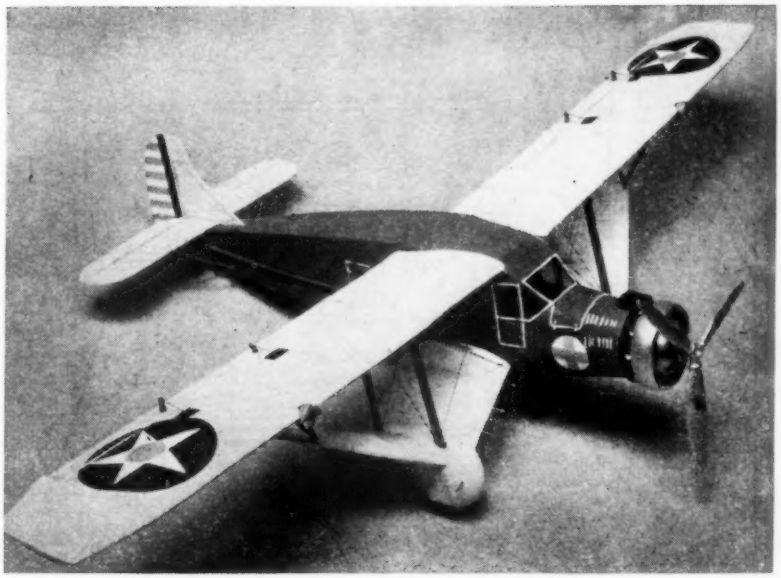
* * *

IN the fifth place is William E. Surginer, Hensley, Ark. Like Mueller, Surginer has his plane equipped with a complete lighting system, and with the exception of the light bulbs and batteries he built all parts of the plane himself. He is the winner of six "Firsts" in model contests and won the 1933 sweepstakes cup in the Arkansas State Championship contest. The landing gear of the model is retractable and the shock-absorbers really function. He says that each of the motor assemblies contain more than 1,100 pieces.

(Concluded on page 327)

A Bellanca Aircruiser Model

by
PAUL W. LINDBERG
Model Editor of POPULAR AVIATION



This completed model of the Bellanca Aircruiser is one of the most beautiful flying scale models that has yet appeared in this department. It is an excellent flyer.

THE Bellanca Aircruiser makes a fine flying scale model. It has been accurately designed to scale and our laboratory tests show this high wing monoplane has plenty of pep and takes the air like its prototype.

The landing gear struts have been cleverly worked into a streamline airfoil section which stabilizes the ship while in flight. Flights of over 300 feet are easily obtained and another beauty of the Bellanca Aircruiser is that you can adjust your controls (for they have aluminum hinges) so that your model will perform exactly as you wish. It can be made to fly a straight course or in a large circle. You will thrill at the sight when she comes in for that three-point landing after the rubber motor has become exhausted.

In the building of the Bellanca Aircruiser all dimensions can be quickly and accurately determined, by placing a ruler on the part to be measured, for the plan is printed full size. If you wish a larger model, multiply this measurement by the amount of increase.

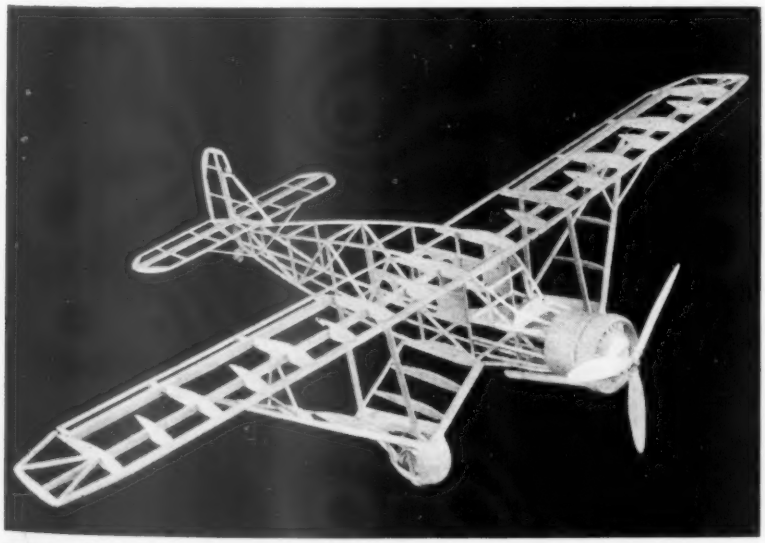
The color scheme can be obtained from the cover of the April issue of POPULAR AVIATION.

CONSTRUCTION OF FUSELAGE

The fuselage sides are built from 1/16 inch square balsa. The longerons, verticals, diagonal braces, etc., are held in place until securely cemented by inserting straight pins on either side of the strips wherever needed.

After the two sides are completed, they are pinned to the top of the plan in such a manner that the top longerons face down and so that the sides form right-angles with the surface of the plan. The cross-members are now cemented in their proper locations. Cut formers from 1/32 inch sheet balsa and cement in their respective positions as shown on plan. These are necessary only at the front of the fuselage, as the rest of the body is more or less square in shape, tapering off to the rear.

A solid balsa block is carved to shape and fitted to front of body. It not only makes a neater model but is also necessary to add the required amount of weight to the nose. Stiff paper is used from solid balsa nose over former one and along sides of cockpit enclosure to receive wind shield. See plan.



Study the framework, particularly the wing frame, very carefully, for the construction is out of the ordinary.

DUMMY MOTOR

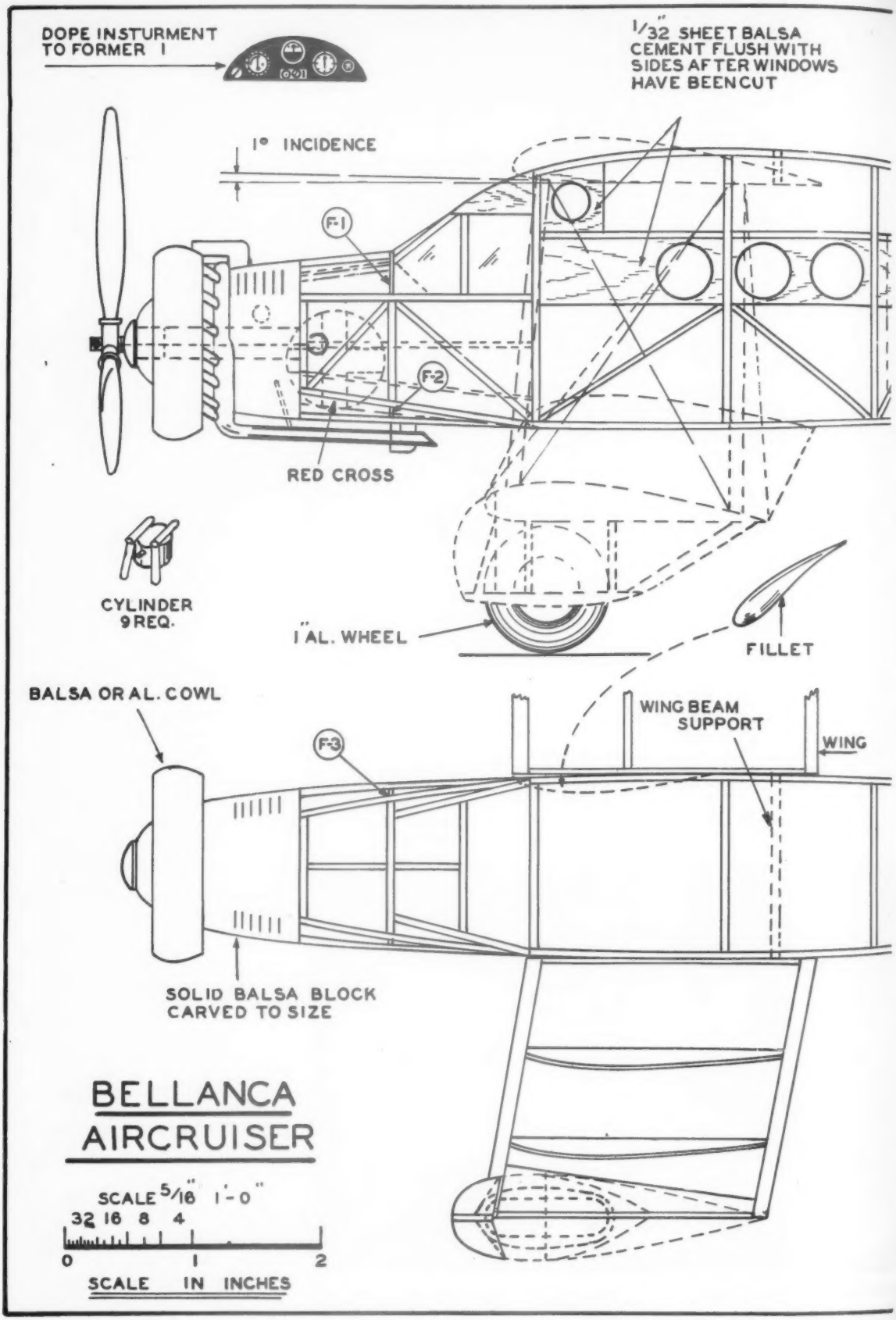
The motor is built up entirely of balsa, using 1/32 inch square strips for rocker arms and push-rods. These are cemented into position after the fuselage has been completely covered and doped. Paint each cylinder black.

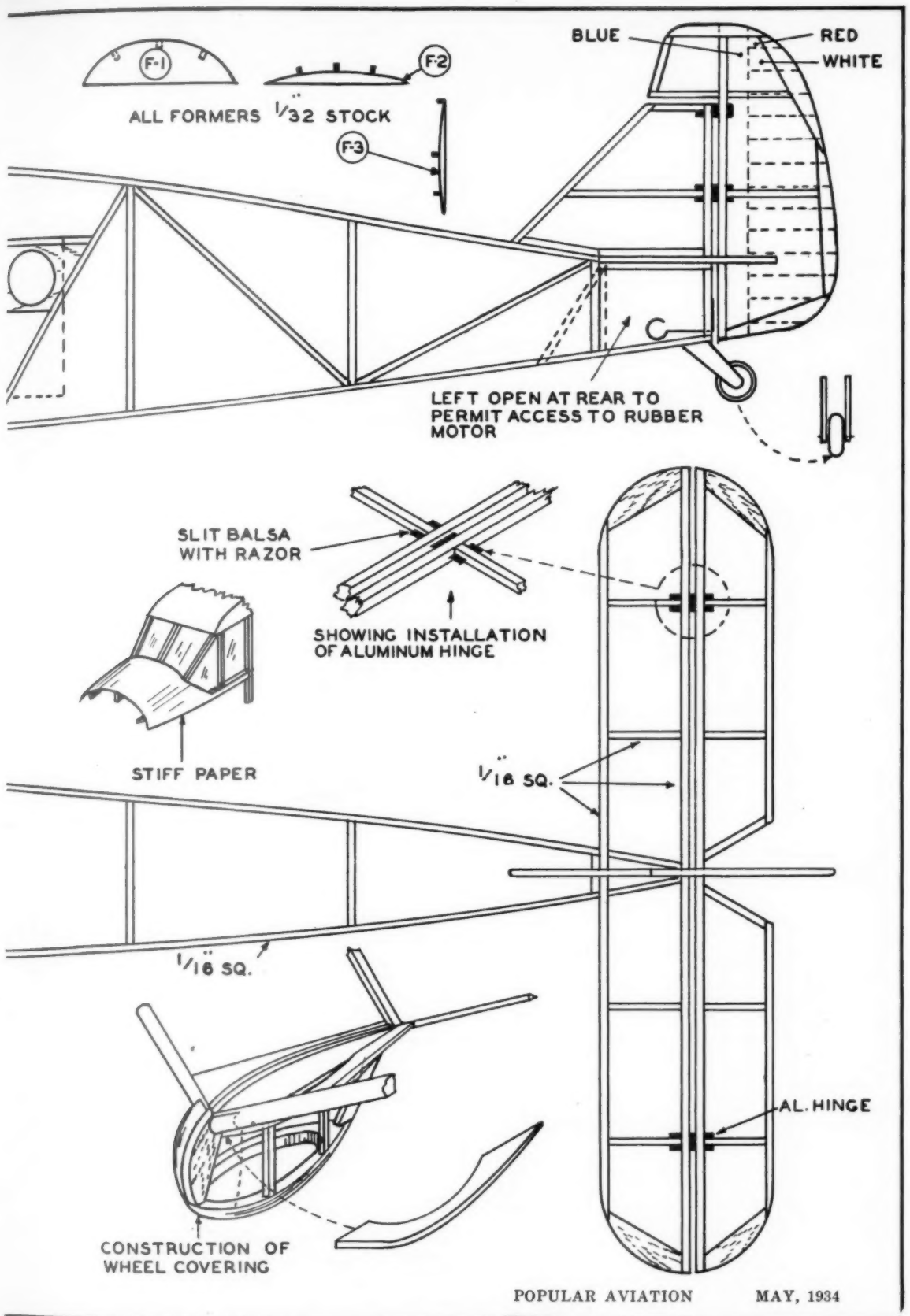
LANDING-GEAR

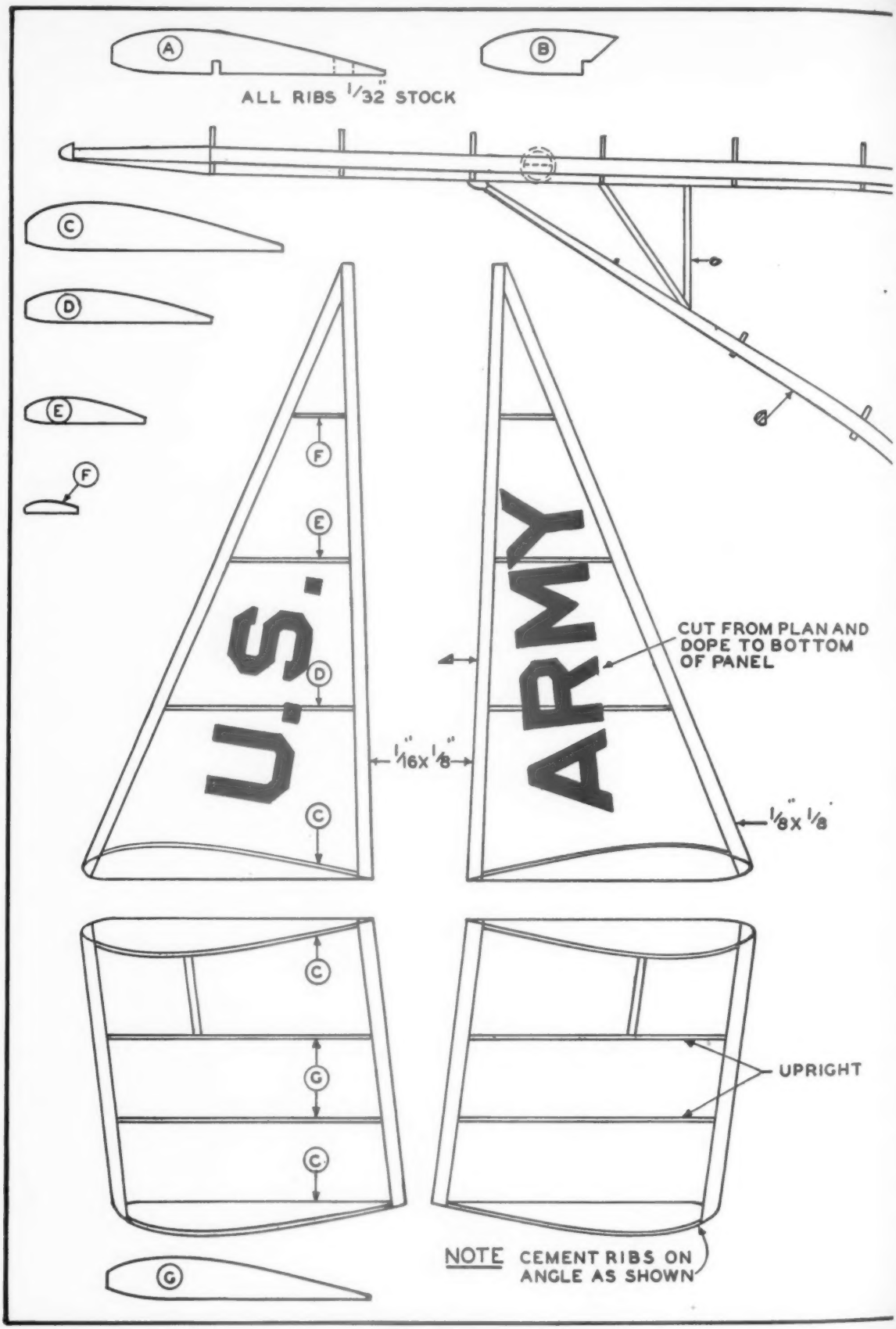
This portion of the ship is built piece by piece. The two struts are built directly upon the plan and it's absolutely necessary that the ribs are cemented at their proper angles as specified. After the parts have become thoroughly dry, remove from plan and cement ribs (C) and (C) at the center so that the proper angle is obtained.

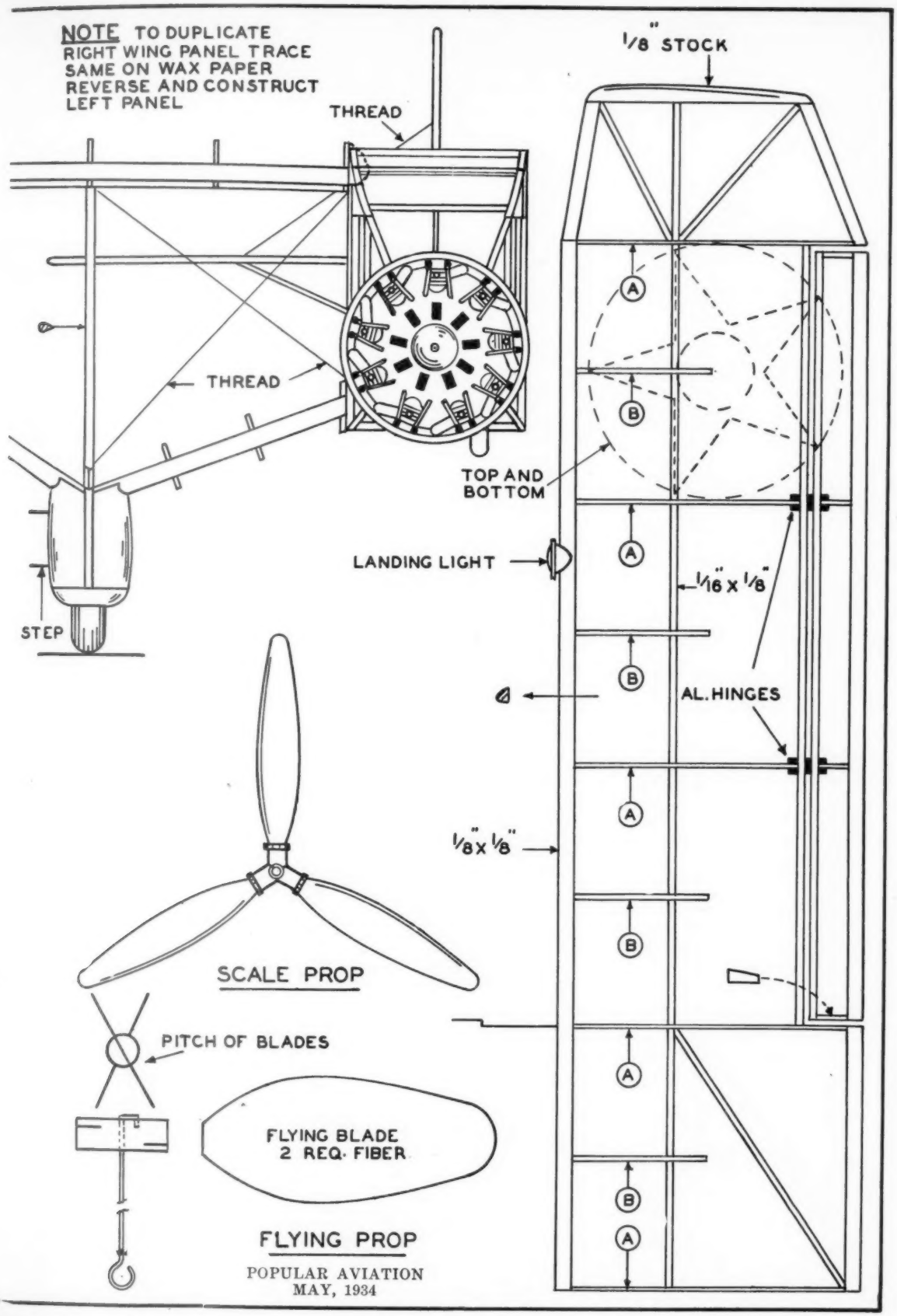
The streamline wheel covering should now be built into the strut. A little patience is required here, but your efforts will be well repaid if this part of the job is given a greater amount of time and attention. Having finished the struts with their streamline wheel coverings, the wheels are now placed in position, with a short length of piano wire passing through wheel and ce-

(*Concluded on page* 344)


DOPE INSTURMENT TO FORMER 1
1/32" SHEET BALSA CEMENT FLUSH WITH SIDES AFTER WINDOWS HAVE BEEN CUT
1° INCIDENCE
F-1
F-2
RED CROSS
CYLINDER 9 REQ.
1" AL. WHEEL
FILLET
BALSA OR AL. COWL
F-3
WING BEAM SUPPORT
WING
SOLID BALSA BLOCK CARVED TO SIZE
BELLANCA AIRCRUISER
SCALE 5/16" 1'-0"
32 16 8 4
0 1 2
SCALE IN INCHES


F-1
F-2
ALL FORMERS 1/32 STOCK
F-3
BLUE
RED
WHITE
LEFT OPEN AT REAR TO PERMIT ACCESS TO RUBBER MOTOR
SLIT BALSA WITH RAZOR
SHOWING INSTALLATION OF ALUMINUM HINGE
STIFF PAPER
1/16 SQ.
1/16 SQ.
AL. HINGE
CONSTRUCTION OF WHEEL COVERING

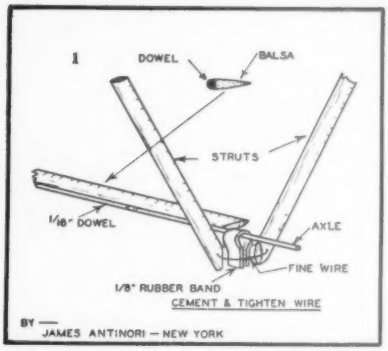

A
B
ALL RIBS 1/32" STOCK
C
D
E
F
F
E
D
C
U.S.
ARMY
1/16X1/8
CUT FROM PLAN AND DOPE TO BOTTOM OF PANEL
1/8X1/8
C
G
C
G
UPRIGHT
NOTE CEMENT RIBS ON ANGLE AS SHOWN



POPULAR AVIATION
MAY, 1934

Helpful Model Hints and Kinks

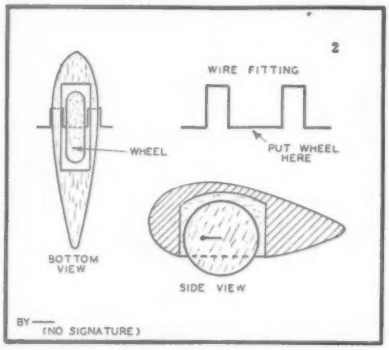
Here are a few ideas, submitted by our readers, for making better models and for making them easier to build. Send in your ideas for this page.



WHACK, down goes the model on the ground. She sat down on her wheels all right, almost a three-pointer, but she's badly mussed up. Too bad.

But, if this model had been provided with the shock-absorber shown above, no damage would have been done because the shock-absorber would have broken the severity of the blow. James Antinori, New York, sent in this design for a shock-absorber and it's a dandy.

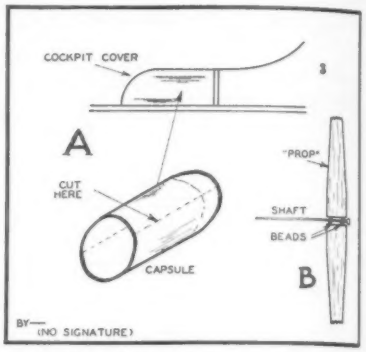
All you do is to apply cement between the struts and the rubber band and then draw up the wire tight so that the joint is solid. You now have a real rubber shock-absorber that will absorb.



IF you have put pants, or rather "spats" on your model, you'll have to do something else for the shock absorption problem.

The reader contributing the solution for this problem omitted to sign his name (he's bashful you know) so we'll have to go on without giving him credit. You can easily see how he makes this absorber without much more description.

He just takes a piece of music wire and bends it up—so, the wheel being in place while bending. The wire is now slipped into the spats, and she's all set. The spring in the wire takes up the shock, but it should be fairly stiff.



HAVE these new-fangled cockpit covers given you a lot of trouble? Well, here's the way that another anonymous writer solves the difficulty.

You see, it's this way. He gets a large size gelatine capsule from his druggist and cuts it in half as shown at (A). Well, that troublesome pest is out of the way and we're all ready for the next surprise at (B).

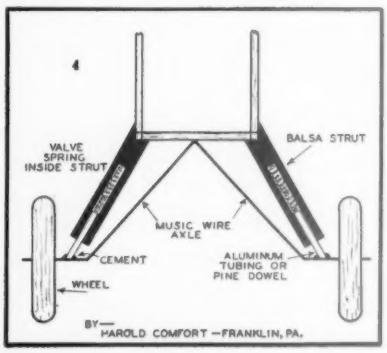
This is a propeller for a non-flying model that swings so freely that it will revolve in the slightest breath of air. This is simple—if you had only thought of it before. He uses beads for the propeller hub and a pin for a shaft.

—and Here are Some More of 'em

IF you would like something fancy in the way of shock-absorbers, the idea submitted by Harold Comfort, Franklin, Pa., will be of value to you. Harold has gone to a lot of work on this job but it is so effective that it is well worth the extra trouble.

Do you see what he has done? Well, he has used a valve "inside" for the absorber, the inside mechanism of a tire valve from a bicycle or automobile, depending upon the size of the model. This has a whole lot of "give" so that it will take a real bump without causing damage.

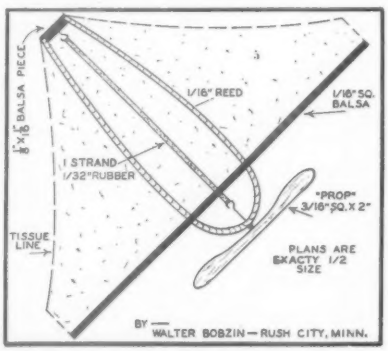
The axle must be braced with flexible wire so that there will be movement.



WALTER BOBZIN, Rush City, Minn., believes in making them small, so here's a half size drawing (Fig. 5) of a sort of mosquito size model, or a butterfly, that really does business on a small scale.

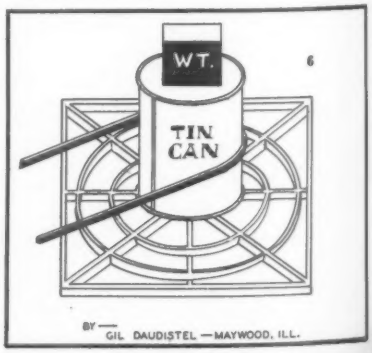
He bends a 1/16 inch reed for the fuselage, puts a piece of balsa in the open end, and then motors the job with one strand of 1/32 inch rubber. (Gee, fellows, this is economical.) Next he runs a 1/16 inch wing spar across the loop and is ready for covering.

All you need in the way of covering is a sheet of tissue cut to the dotted lines. Next, is the two inch prop, and she's all ready to scoot around the room like nobody's business.



BENDING reed, balsa or bamboo for the wing tip bows is often a troublesome job and we don't always get as neat a job as we might wish. The wood must be heated, and there is always a fine chance of burning it before completion.

Gil Daudistel, Maywood, Ill., thought this matter over and came to the conclusion in Fig. 6. He places an empty tin can on the gas stove (open end down) and turns the flame low. The hot can supplies an even mild heat that does the trick. He suggests that a different size can for each size of bend, but this is easy for him to say, for there is a tin can factory in Maywood where he lives.



What the Industry is Doing

Latest bulletins from the airplane, engine, equipment manufacturers and dealers boiled down into a nutshell. Contributions to this department are invited.

BOEING AIRPLANE COMPANY, Seattle, Wash., is delivering three Boeing "247" Low-wing transort planes to a European transport company for operation on the London-Paris lines. These planes are each equipped with two 550 h.p. supercharged Wasp engines and Hamilton controllable pitch propellers. This is the first sale made in Europe of American made multi-motor transport planes.

AMERICAN operated airlines, including domestic and foreign extensions, carried 568,940 passengers during the calendar year of 1933. This, according to the Department of Commerce, is an increase of about 28,000 over the previous year.

FLY AMERICAN is a two-reel sound production just completed by American Airways, Inc. It is used as a publicity feature and shows the many ways in which commercial aviation is employed in the United States.

MANUFACTURERS will be interested in a product known as Stonehard Stonehide which will stop driving rain from leaking through brick, stone or concrete hangar or factory walls.

DRAFTSMEN will be interested in a new lettering guide which has recently been imported by the Keuffel & Esser Company. The guides are so arranged that there is no chance of blotting or smearing ink, and a large variety and sizes of letters are included.

BOEING School of Aeronautics, Oakland, Calif., have developed a new series of extension courses covering various phases of transport operations. The course is particularly designed to meet the needs of persons now employed in the aviation industry and are now available to such persons. A home-study division has been created and applications for enrollments may be obtained from that division, Oakland Municipal Airport, Oakland, Calif.

WESTERN ELECTRIC COMPANY, 195 Broadway, New York, have issued a comprehensive bulletin on their aviation communication equipment, Type 208. Commercial transport operators should be interested in the equipment described, therein.

NORTH AMERICAN AVIATION, INC., shows a consolidated loss for the year 1933, of $1,104,451.41. The air transport division showed a loss from operations, largely due to decreased mail revenues, but the passenger and air-express shipments are increasing rapidly, though not as yet in sufficient volume to offset the loss of air-mail revenue.

AFTER 18-months of construction, the new Sikorsky S-42, is now ready for its flying tests. It was built for Pan American Airways, Inc., and is the largest flying boat in the United States.

KOLLSMAN INSTRUMENT COMPANY, 1 Junius St., Brooklyn, N. Y., have issued a complete catalogue of their precision aircraft instruments which should be in the hands of pilots and aircraft manufacturers. This includes altimeters, level flight indicators, air-speed indicators, electric tachometers, compasses, fuel level indicators, manifold pressure gauges, etc.

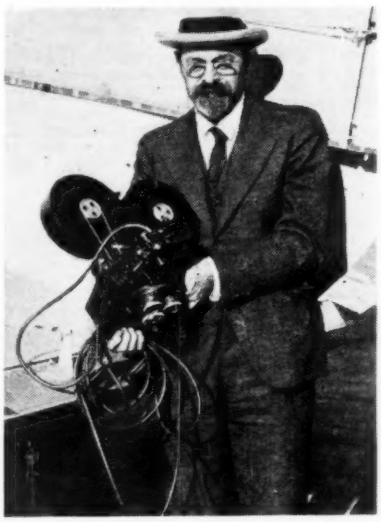
THE NAVY PROGRAM for 1934, calls for 1,184 new planes and engines to cost $90,000,000 in addition to maintaining its present complement of 1,000 serviceable units. The Army program calls for about 1,150 new planes and engines to cost $45,000,000. This will bring the total effective strength of both Army and Navy to 4,834 planes and a total expenditure of $135,000,000 for American manufacturing companies.

SECRET flight tests were recently conducted on a new Northrup low-wing monoplane designed for the U. S. Navy. It is the fastest fighter in the world and there are reports of top speeds of from 275 to 300 m.p.h., although no official statement has been made. It is powered by a 14-cylinder Wright engine and has a wing span of approximately 14 feet.

ANOTHER new Northrup fighter has been designed and built for the U. S. Army. It carries 5 machine guns and a load of bombs. At the present time, the Northrup Company have unfilled orders on hand amounting to $1,800,000.

AIRMAIL carried on domestic and foreign routes by American operators totaled 7,816,532 pounds in 1933 as against 7,908,723 pounds in the previous year. Of this weight, the domestic air-mail amounted to 7,362,180 pounds.

LATHES suitable for manufacturing, repairs and experimental work are described in a new catalogue issued by the South Bend Lathe Works,



The new automatic Bell & Howell airplane motion picture camera devised for strip-mapping and exploring.

South Bend, Ind. Lathes of every class and size are built by this favorably known concern.

A SURVEY made recently by the Department of Commerce, disclosed the fact that 504 airplanes were in operation on scheduled airlines at the end of 1933 and that these craft consumed 26,326,796 gallons of gasoline and 924,411 gallons of oil during the year. This figure does not include the gasoline and oil consumed by military and privately owned aircraft. Slowly but surely, the airlines are beginning to be a factor in the oil refining business.

SUSPENSION of airmail carrying by commercial airlines promises to put a large size dent into the manufacturing division of aviation as well as the operators unless the contracts are released.

A-12 ATTACK PLANES, one of the most effective offensive weapons ever developed, are being built for the U. S. Army Air Corps by the Curtiss Aeroplane and Motor Company, Buffalo, N. Y. There are 46 of these planes now on order. The A-12 Attack plane is powered by a 700 h.p. Wright Cyclone engine and is the successor to the A-8 Shrike which have been in service over one year. The Shrike was powered with a liquid-cooled 650 h.p. Curtiss Conqueror engine.

BUDA Diesel engines, built by the Buda Company, Harvey, Ill., are being offered as a cheap and satisfactory source of power for airports, airplane factories and other branches of the industry where skilled attendants are not available.

AIRLINES of the United States furnished employment for 543 pilots, 206 co-pilots, 2,320 mechanics and ground crew men, 1,834 other hangar and field personnel, 1,370 operation and office personnel.

SAFETY gasoline is a new product now being tested out at Roosevelt Field, Mineola, N. Y. It requires a redesigned carburetion system, and at a recent demonstration, numerous successful flights were made on a J-5 Sikorsky which used this hydrogenated non-inflammable fuel. Should this prove out, it will mark a great advance in the safety of aviation.

A GROUP of technical men engaged in filming the industrial activities of the Gulf Refining Company, were flown in a Lockheed Vega during the last few weeks on their mission about the United States.

A NEW Lockheed plane was introduced recently which has a novel means of enclosing both engines of a bi-motored plane within a single streamlined housing. This, it is said, presents less resistance than the common arranged of independent motor nacelles and is on a line with recent developments at the Lockheed plant.

GENERAL AVIATION MANUFACTURING CORPORATION, Baltimore, Md., had flight tests made on Model 34 transport plane by the Department of Commerce Inspection Department. The plane is a ten passenger all-metal monoplane powered with a 700 h.p. Wright "F" Cyclone engine. It has a top speed of about 200 m.p.h.

AERIAL EXPLORATIONS INC., have just completed an aerial mapping project over Westchester, N. Y., and over New York City. They also have a contract for photographing an area of 2,300 square miles in Virginia.

A SHIPMENT of 12 wild ducks was made from California to New York recently over the Air Express. They were eaten one day after they were killed in California at a New York banquet, and this is some test of speed.

EVEN the pigeons are tuning up their powerplants. One thousand homer pigeons raced back to Ontario, Canada, recently from Danville, Ill. The winning bird averaged 3,318 feet per minute which is about 40 m.p.h.

AIR TRANSPORT EQUIPMENT COMPANY, Roosevelt Field, Mineola, N. Y., have developed a device to reinforce the cylinder heads of Warner Aviation engines. This device has been tested and found successful on a Warner-Fleet.

WRIGHT-AERONAUTICAL CORPORATION reports pending contracts amounting to $2,400,000 with the Soviet Government. This government has already placed contracts for $400,000 with the Wright Company and more than half the engines ordered have been delivered.

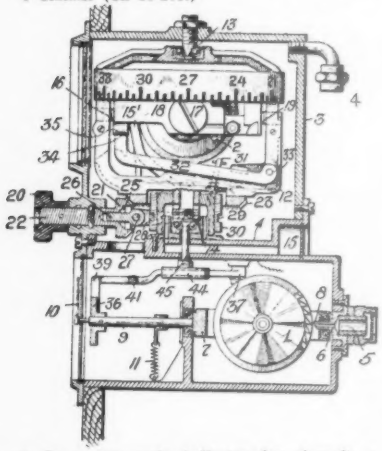
THE new V-90 series, Vought Corsair, a 2-seater, has greatly improved performance. The speed at 6,000 feet altitude is 184 m.p.h., climb in 10-minutes is 13,000 feet and the service ceiling is 23,700 feet.

L. E. SHEDENHELM, engine instructor at Parks Air College, East St. Louis, Ill., presented a paper at a meeting of the Young Mens' Division of the St. Louis Chamber of Commerce. His subject was: "The Aircraft Engine, The Most Interesting Engine in the World."

Recent Patents in Aviation

Information for this department is supplied by Rummler, Rummler and Woodworth, Patent Lawyers and Engineers, 7 So. Dearborn St., Chicago, Ill. Tell us how you like this department.

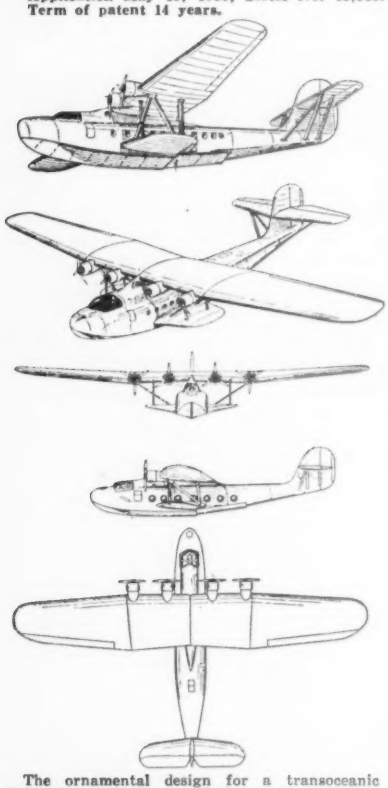
GYROSCOPIC DEVICE. No. 1,946,657.
Stephen J. Zand, Forest Hills, N. Y., assignor to Sperry Gyroscope Company, Inc., Brooklyn, N. Y., a corporation of New York.
Application March 15, 1933. Serial No. 660,801. 4 Claims. (Cl. 33-204.)



1. In a gyroscopic indicator for aircraft, a turn indicator gyroscope, a free directional gyroscope, means for maintaining the latter normally locked, and means operated by precession of said turn gyroscope for releasing said directional gyroscope during a turn.

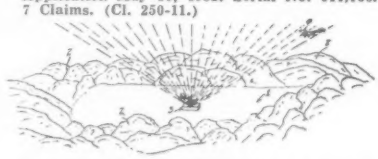
* * *

DESIGN FOR A TRANSOCEANIC FLYING BOAT. No. 91,634.
Lessiter C. Milburn, Towson, Md., assignor to The Glenn L. Martin Company, Baltimore, Md.
Application May 13, 1933, Serial No. 48,113. Term of patent 14 years.



The ornamental design for a transoceanic flying boat of the sesqui-plane type, substantially as shown and described.

RAY AVIATION COMPASS. No. 1,948,552.
Sigvard Leo Weber, Brydon Baker and Edward W. Jensen, Los Angeles, Calif.
Application May 16, 1932. Serial No. 611,466. 7 Claims. (Cl. 250-11.)



3. In navigation, the method of indicating the direction of a reference point on a board a moving craft that comprises radiating Roentgen rays from the reference point, intercepting some of said rays on board such craft, and determining the direction of propagation of the intercepted rays.

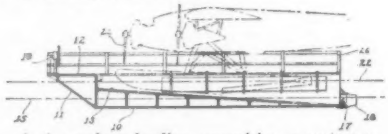
* * *

AIRCRAFT COVERING. No. 1,944,990.
Franco Mazzini, Milan, Italy, assignor to Societa' Italiana Ernesto Breda Per Costruzioni Meccaniche, Milan, Italy.
Application November 23, 1931, Serial No. 576,841, and in Italy January 28, 1931. 3 claims. (Cl. 244-31.)

1. A covering for aircraft wings and the like, including a thin metal sheet having short elongated bosses spaced apart and connected by lineal reduced protuberances, said bosses extending in the direction of flight of the aircraft, whereby to provide stiffening means which permits the sheet to assume any desired curvature without impairing its rigidity.

* * *

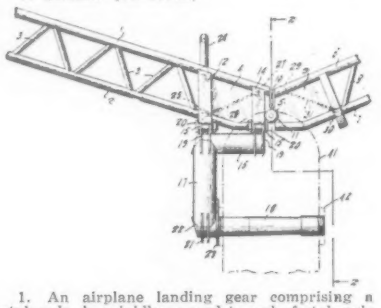
SEAPLANE LANDING FLOAT. No. 1,937,973.
William B. Mayo, Detroit, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware.
Application December 18, 1931. Serial No. 581,889. 2 Claims. (Cl. 114-0.5.)



1. A seaplane landing comprising a rectangular float with raised deck extending around front and two sides, center portion having a normally submerged deck spaced a lesser distance from the bottom of the float. Submerged deck is inclined from its forward edge down where it intersects floor of float at rear. Substantially vertical side walls connecting raised deck with said submerged deck to form a watertight compartment between float and decks. Manually operated valves for permitting water to enter space betwen decks and means of pumping water from float, whereby said submerged deck may be raised out of the water. A water-tight engine compartment sunk in each floor of raised decks, each compartment having an engine herein adapted to actuate a propeller disposed at rear of each raised deck portion.

* * *

LANDING GEAR. No. 1,943,783.
Giuseppe M. Bellanca, New Castle, Del.
Application July 2, 1931. Serial No. 548,438. 11 Claims. (Cl. 244-2.)



1. An airplane landing gear comprising a stub axle, leg rigidly secured to end of stub axle and formed, at its other end, with a lateral extension parallel to stub axle, means spaced apart on extension to pivot it to airplane, a compressible unit with one end pivoted to said leg and other end connected to airplane and a wheel mounted on stub axle.

Practical Lessons

(*Continued from page* 308)

Airfoil (J) is the U. S. A. 27 which is characterized by a slight central camber in the lower surface and with the trailing edge above the datum line. It has a lift-drag ratio of 18.8 and an excellent maximum lifting value.

The Clark "Y" section, shown at (K), is one of the most popular all-round-wings ever designed and has been used by many constructors, both professional and amateurs, in this country. It has a flat under surface with the nose elevated above the datum line, and is deep enough for good spars at both front and rear. In addition, these wing ribs are very easy to make because of the absence of complicated curves. The lift-drag ratio is 21.1, and while the load carrying value is not as great as that of the U. S. A. 27, yet it is comparatively high.

These sections are very deep and a long way from the early cambered plates and sky-hooks, yet they have a higher ratio of lift and drag than the former airfoils and give better all round performance. The lift-drag of the Bleriot wing (B), for example, is 11.25, while that of the Clark "Y" is 21.1, or nearly twice that of the old wing. It will also be noticed that the camber of the lower surface has been brought down progressively from the deep under camber of airfoils (A) and (B) to the absolutely flat under surface of the Clark "Y."

And now we will enter into another phase of wing design wherein a further alteration has been made in the under surface. From being flat, the designers now have started to make the under-surface actually convex or "double-cambered."

Airfoil (L) shows the C-62 with a "negative" lower camber falling below the datum line. This permits good space for the spars with a comparatively flat top surface, which is sometimes desirable. It has a very high lift-drag, 21.8, and a fairly good lift value. This section is well adapted to speed or racing machines.

At (M) is a typical "tear-drop" airfoil known as the Göttingen No. 225, but it is actually taken from the developments of the Russian engineer, Joukowsky. It is convex for a distance on the bottom and then concave, giving a good spar space at the leading edge but an impractically small depth at the rear. This airfoil is the father of a large series of deep sections developed here and abroad since these deep sections are necessary to accommodate the deep spars required for the wings of cantilever winged monoplanes.

A further development (see airfoil N) is the Göttingen No. 387, an airfoil particularly adapted for deep sparred cantilever monoplane wings. The great depth of both spars is apparent, making it possible to do away with external wing bracing and stays. The lift-drag ratio is not high, 17.0, but this section

has excellent lifting value, second only to No. 225.

At (O) is the U. S. A. 35A deep section with even more spar room than the No. 387. The U. S. A. 35A has the highest lifting value of all the wings listed, but its lift-drag ratio is only 15.7. A later airfoil, the C-72, is very similar to the U. S. A. 35A, but is modified so that its lift-drag is very much improved, the new section having a lift-drag ratio of 21.2. This shows, how, by small alterations in the curvature, the characteristics of an airfoil can often be improved.

Of the very modern sections (1931) brought out during the past few years, the American section, M-6, is of great interest. This airfoil shown at (P) is a double cambered type of great stability. The center of pressure position does not vary through a wide range of angles, due to the design of the lower convex surface. It has a lift-drag ratio of about 21.0 and a high value of lift. It affords space for deep spars at the front and rear so that it is an excellent airfoil for many purposes, but particularly where good stability is desired.

Very similar in appearance to the M-6 is the C-80 shown at (Q). The C-80 is thinner with less spar space and there is a difference in the shape of the lower surface, but the lift-drag ratio is enormously increased, becoming 23.2 at an angle of attack of 4.2 degrees. This fits the section for racing and other high speed work but at the sacrifice of other valuable qualities.

On looking the various airfoils over, we notice that they have increased enormously in depth from the early wings to the latest deep wings designed for cantilever planes, and at the same time, that this increased depth has led to improved performance. This seems to be contrary to the principles of air resistance but it really confirms these laws if we stop and consider the various factors entering into resistance.

If we look at these airfoils progressively, beginning with the earliest and simplest and going down to the latest deep sections, we will notice that the latter wings approach more and more to a streamline form. In other words, the modern efficient wing sections are really streamline bodies, distorted to give lift by flattening one side or else by simply twisting the streamline body around an arc so that the greatest convexity will be on the upper side.

This is illustrated by Fig. 4, where a streamline body at the top of the sketch is twisted around an arc in Fig. 4 to form a lifting surface or airfoil. This suggests a law that the lift is directed away from the side of greatest convexity. If the body is straight and with equal convexity on either side, there will be no lift in either direction if the center is parallel with the air stream.

END.

Model Contest

(Continued from page 318)

HARRY THORNTON, 41 Allison Ave., East Toledo, Ohio, is winner of the sixth prize. This is his first model and his first contest, which is quite remarkable for a sixth place winner. He received the glad news of passing the preliminary eliminations on his 22nd birthday. The only parts purchased were the propellers, anti-drag rings and wheels.

* * *

TOM CAGE, 12701 Rexwood Ave., Cleveland, Ohio, is the winner of the seventh prize. He has been building models for five years and at present is a junior in highschool. He built his winning model from a Cleveland Model and Supply Company kit and has invested about $20 in the contest. His age is 17 years.

* * *

THE winners of the fourth, fifth, sixth and seventh prizes receive the beautiful 20-inch trophy of the "247" Boeing transport mounted upon an ornamental pedestal.

Model Fans, Note!

WE have received a letter from radio station KFI, Los Angeles, Calif., that this station and the local office of United Airlines, held an auxiliary model contest in that city.

KFI and United Airlines awarded additional prizes to the winners of the P. A. Contest that were residents of Southern California. And so—these fortunate Californians got two separate prizes. We will publish the story of this secondary contest in our next issue.

And now follows the third group of major prize winners in the eighth, ninth and tenth places who will receive as a reward an authorized inspection trip at the nearest United Air Line airport under the escort of one of the pilots who will describe in full the details of the large ship and the operation of this huge airway.

* * *

KAREL VALASEK, 1424 Farragut Ave., Chicago, Ill., is the winner of the eighth prize. He has been building models for nearly seven years and was a winner of a bronze medal back in 1928 for a model of a Ford Trimotor. Later, and with the same model, he won a Kiwanis Club model in second place. Mr. Valasek is 21 years old and has been a reader of POPULAR AVIATION since 1927.

* * *

THE winner of the ninth prize, Robert A. Willoughby, 4109 Highland Ave., Kansas City, Mo., is the only entrant connected with model aviation in a commercial way. His model also was equipped with batteries and flashlight bulbs and had a very praiseworthy retractable landing gear. He has a most interesting biography which we will relate in part.

Mr. Willoughby is president of the Model Airplane Engineers of Kansas City, Mo., from which organization he has received a loving cup for winning the greatest number of monthly model contests held over a period of one year. He has also won numerous prizes in the city contests held every year by the Chamber of Commerce. His biggest victory, however, was winning first place in the Skelly Oil Outdoor Fuselage Contest held at Fairfax Airport, Kansas City Kan. His time in this contest was 6 minutes 33 seconds. His model was lost to sight from binoculars in ten minutes at approximately 2,000 feet and was never found again. This flight placed him third in the International Miniature Aircraft Tournament (Sweepstakes rating) correspondence contest held in California, 1932.

'Way back in 1929 he won the Kansas City American Royal Scale model contest and was placed seventh in the third A. M. L. A. scale contest.

* * *

THEN, in tenth place, we have Heran Hahn, 105 S. Eaton St., Albion, Mich., age 18 years. His model had a removable top so that it was easy to view the detail of the cabin interior on which Herman spent a lot of work. He says he stuck at the job six hours per day for about five weeks. He holds the championship for economy, as he claims that it cost him only 60 cents, exclusive of the crate.

It is a very nice job, the interior work being particularly good, and in a less strenuous competition, this model would have stood well toward the front.

* * *

SUMMING up the results of this memorable contest, we will get statistical for a moment, not that it matters but the figures are illuminative.

Of all our winners, only one held a pilot's license and only one was engaged in model building professionally. The youngest winner was 17 years of age, while the oldest was 29. By far the greater majority were in the 20 to 21 year zone. This is a higher age rating than in our last year's contest, where the average ran from 17 to 18 years of age. The oldest man in this contest was 37 years of age and he, of course, did not need his parents' consent to take a trip.

Many of the winners, as might be expected, had also been winners in many other contests and had been engaged in model building for many years, but in contradiction to this general statement the winner of the third prize had never built a model before. The greatest amount of money spent on the model was $30, while the least expenditure was 60 cents. So, you see, money does not mean so much after all.

But there is one thing that we will emphasize, and that is the fact that the boxing and packing of the models this year was far better than last year. The breakage in this contest was an absolute minimum. And so we leave you—see you next year.

END.

Oil Men

(*Continued from page 294*)

tion department of this company and many others.

Standard Oil Company of Indiana was a pioneer in impressing the public of its territory with the importance and great future of commercial and general business flying. The company bought several large and small planes of various types from time to time and demonstrated by plane rides to numberless customers, friends, employes of the company. Not only that, but the use of the planes became actual routine and especially so with officials of the company in their business.

It is in the great western and southwestern sections of the country that flying has made particular friends in the oil industry. These are the regions of great distances and are also generally favorable flying conditions. Developments of oil production in those sections and the nature of oil production make the use of planes vital to present-day style and scale of oil industry operations.

Gulf Refining Company, Pittsburgh, is active in conducting an aviation department, and in studying the interrelated future of the two industries. This is a unit in the Gulf Oil Corporation, active in all branches of the industry, marketing mainly in the east and the south, dominated by the Mellon interests. It is a leading "independent major" company of the most powerful rank. Sinclair, now Consolidated Oil, cashes in on air development in various ways, particularly in bidding for government supply projects and in actively advertising the fact that it supplies the army, navy, etc., with aviation fuels and lubricants.

Cities Service (Doherty) is closely following aviation developments through its various subsidiary companies, known mostly by the appellation, Empire, scattered generally throughout the country except on the Pacific Coast.

Phillips Petroleum Company, an aggressive independent major which has gained rapid dominance in central states' activities, is becoming closely identified with aviation mainly through support given various air race and long-distance flight competition by itself and its head, Frank Phillips.

Socony-Vacuum Corporation, recent merger of Standard of New York and Vacuum, taking in Magnolia Petroleum, General Petroleum, White Eagle, White Star, Lubrite, Wadhams and numerous others, is an active backer of aviation and maintains a world-organization for marketing general petroleum products, in which items for aviation are becoming of growing importance.

Tide Water Associated Oil, another company resulting from merger several years ago, is known for its interest in unusual aviation accomplishments and has in the last few years given support to several outstanding projects of the air.

Skelly Oil Company is one of the smaller major organizations which has been closely affiliated with aviation activities in the southwestern oil country, especially through activity of its president, W. G. Skelly, in aiding development of commercial flying ventures. Continental Oil, which many consider the nucleus of a future dominating major group, enjoying the backing of Morgan banking, is closely interested in aeronautics and is doing its share in promoting and encouraging various activities. Ohio Oil Company, an old one-time Standard unit before the days of the "Dissolution," is much interested in aviation movements through its various subsidiaries, which operate mostly in the Southwest and the Middle West.

Barnsdall Corporation, through subsidiary companies, is known as an active champion of specialty and off-shoot activities related to the oil business and is keeping a close eye on air developments. Pure Oil, backed by the Dawes family, also is a close follower of "things aeronautic." It has in mind activities in connection with aviation sooner or later.

Standard Oil Company of Ohio, although in restricted territory, is actively championing the cause and is contributing much study. Standard Oil of Kentucky is another of the Standard group in the same general category. Standard of California, as mentioned above, has been extremely active in aviation-promotion ways.

Richfield Oil Company, Pan-American Petroleum, Mid-Continent Petroleum Corporation, Humble Oil and Refining Company, National Refining Company, Midwest Refining Company, Indian Refining Company, Sun Oil Company, Colonial-Beacon, Atlantic Refining Company, Union Oil Company of California, Simms Oil Company, Standard Oil Company of Louisiana, Louisiana Oil Refining Company are either independent major concerns or subsidiaries of other companies which have men or departments cooperating with the industry closely in formulating new policies and plans for aviation development.

In addition, there are numerous specializing lubricating oil refiners bidding aggressively for air business, such as Kendall, Pennzoil, etc.

END.

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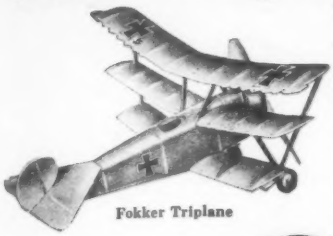
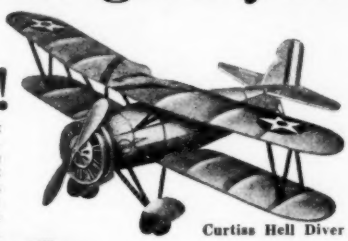


Fokker Triplane



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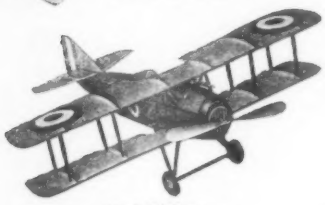
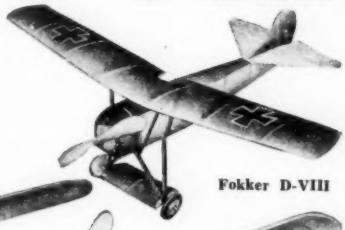


Spad Biplane



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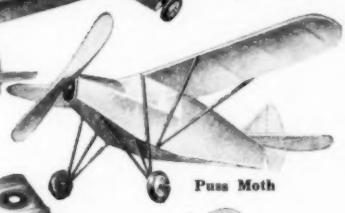
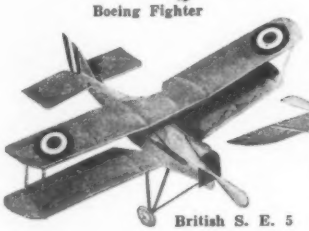
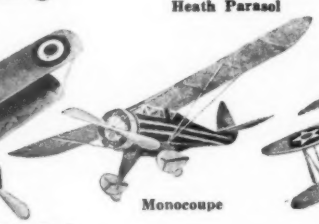


Puss Moth

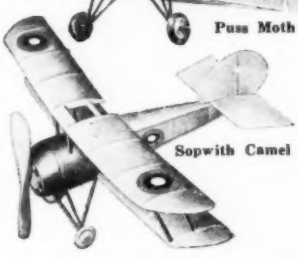


British S. E. 5

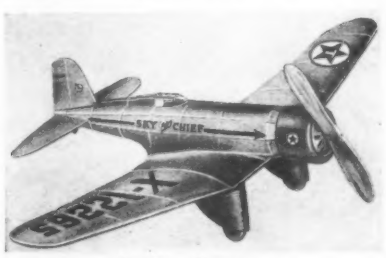


Monocoupe

Curtiss Sparrow Hawk



Sopwith Camel



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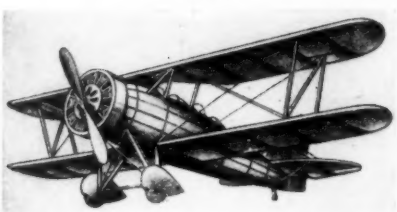
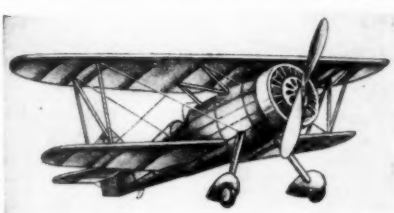
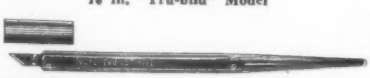


Vought Corsair V-65, 16-in. "Tru-bild" Model



Curtiss Cyclone Hawk, 16-in. "Tru-bild" Model



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Lightplanes

(*Continued from page* 312)

tuck Navy splice. Number 20 copper wire serves well for wrapping. The splice is served with thin cord, and shellacked to prevent the ends from cutting the hands. All pulleys should be of large diameter with a deep groove and should be well greased after installation.

For the average lightship, one-eighth inch cable is about the right size to use for controls, but if the elevators have a single horn, which, therefore, makes use of but two cables for elevator control, it would be wiser to use a little heavier cable.

After all the above has been attended to, you are ready to install the instruments. For a mounting board you have your choice of plywood, aluminum or dural sheet. The old type has been one-fourth inch plywood, but lately most builders favor the use of dural sheet, about eighteen gauge, cut to shape. No doubt, dural makes a neater board, but the expense and weight is greater. No matter what type of material used, the instruments should be arranged neatly, general practice favoring the engine instruments on the right and flight instruments on the left. Compass is usually mounted in top center. For ordinary flying, the only instruments that will be found necessary are: Switch, tachometer, oil pressure gauge, oil or water temperature gauge and altimeter. A bank-indicator and an airspeed indicator will prove themselves handy many a time. If cross-country trips are planned, a compass will be essential.

There are a few precautions that are to be taken in the installation of the instruments that may be well to mention. First, on installing the compass, you should use some sort of rubber or felt cushion, if it is not already on the instrument. This cushion may take the form of sponge-rubber or felt-washers between the compass and the mounting board. This serves to prevent compass vibration, and helps toward a more accurate compass. In connecting up your switch, be sure that it is grounded properly, and the right connections are made to the mag. The oil pressure gauge is connected in such a manner that it indicates the pressure at which the oil is being forced through the system. It will pay to connect up oil pressure gauge lines very tight or you may be bothered with an oily ship.

In connecting up the oil or water temperature gauges do not under any condition kink the capillary tubing that leads from the bulb to the indicator. This tube has a bore of about one sixty-fourth of an inch, and it will be easy to block if kinked.

Most likely, you will find that the capillary tubing is too long, and if this is the case, the surplus should be coiled up in a circle around five inches in diameter, well taped, and then taped to the motor-mount near the bulb. For an air-cooled engine, the bulb is installed to indicate the temperature of the ingoing oil, and this should be borne in mind when making up lines. In a water-cooled job, the temperature bulb should show the temperature of the outgoing water.

When installing the tachometer, be sure that it is in such a position that the shaft will have a tolerably straight lead to the tach fitting on the engine. The tach-shaft usually runs off the camshaft and, on most engines, this will make an adapter necessary. The tach-shaft should be taped down about every foot or so to prevent whipping, and should make no sharp curves.

For the average lightship with a converted engine, a suitable tach can be made from one of those old dial speedometers that were used in automobiles. The mileage mechanism is removed, and a new blank dial made. Then the speedometer is calibrated or compared with some shaft whose revs are known, and marked on the dial. Such an instrument will be found fairly accurate, and will register up to 3,000 r.p.m. Ordinary speedometer shafting will serve splendidly for connecting up such an instrument.

It will pay, in the end, to buy a good altimeter for your ship. Most of the cheap ones sold at bargain prices are too inaccurate to be of any use at the low altitudes that most lightships will be flown. You want to get an altimeter that is accurate up to around ten thousand feet, for it is seldom that many lightships are flown over that altitude. Another instrument that you will find handy is one of those ball or bubble bank indicators. They are best mounted in the center of the board, and the ship should be level laterally when the position for the instrument is marked out. Such an instrument helps in keeping the ship level and in maintaining the proper amount of bank when turning. The bubble will stay in the center if the bank is correct when turning.

Now that you have your fuselage, mount, landing gear and all the furnishings completely assembled, it can be laid to one side till the rest of the ship is completed and then covered with the rest of the ship.

END.

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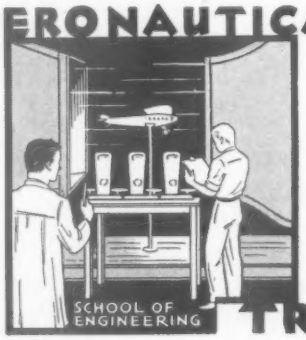

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Aero-Sportswomen

(*Continued from page* 304)

Mon Dieu, what amazing experiences that child is having. She has been in Russia nearly four years, with the exception of one six months' visit home. Assisting around-the-world flyers was a frequent occurrence for her a year or so ago; her engineering father is stationed down in the Caucasus and that has meant frequent trips to the south of Russia, excursions into the fabled land of the Georgian princes (probably interesting, even if most of the Princes are in Hollywood) and there have been walking tours with famous novelists.

She started for home a second time, of that she wrote: "In May (1932) Beth and I said goodby to the gang and with tears in our eyes left Moscow never to return again. Took a trip through southern Russia, boarded a cargo boat at Odessa and three weeks later landed in Brindisi via Istanbul, Athens and the Mediterranean. Dashed through Naples and Rome to Paris, breezed over to London for the R.A.F. show the end of June; was supposed to sail for America in July, but it didn't sound very exciting, what with the depression and everyone advising us not to come home unless we had to, Beth was strong and went anyway but I came back to Moscow."

When we cabled Fay to interview a famous flyer last fall she was in Tashkent, which is only four days and nights by rail southeast of Moscow, but it had taken 17 days to fly down! She had a chance to fly down in a 10 passenger transport that was being ferried down there for use on the Uzbeikistan Airways in Asiatic Russia, the delays were due to minor difficulties with the engines.

Being the only woman on the trip, she said: "I wouldn't have missed that flight for anything, the men were the best sports and we laughed all day long. Honestly the solicitous attention they showered on me was something spoiling—had an awful time getting back to normal when I got back to Moscow."

And now, after living all over Europe and the Near East, she adds this present tour of Siberia and the Orient.

How many flyers or non-flyers have ever had this good fortune to make intimate investigation of these mysterious regions so far off the beaten track of travel? And to add to the charm of this amazing experience is the possibility of real adventure!

We wrote to her in Tokyo and suggested that when she becomes surfeited, to the point of complete saturation with new scenes, new customs, strange sights, smells, sounds and fantastic illusions, that she take time out to digest a part of it and write us a story about it. We know from experience that, that is one way to orient oneself in a strange experience; writing crystallizes the impressions and helps to get it out of one's system.

END.

The Skoda

(*Continued from page* 290)

tion, and hence the noise of the motor, this noise has been deadened by the insertion of brass shims or bearing points, it having been discovered that this metal transmits less noise than any other. The walls of the cabin are double throughout with an air space between and finally the cabin is floored and lined with inlaid wood, very fine central-European hardwoods being used. It is the inlay as much as the wood itself that has a dampening effect on sounds. The total result is that a conversation can be carried on in the cabin in an ordinary tone of voice.

In performance, the new Avia-51s compare favorably with any craft in service in Europe; several of them have already been installed on the Prague-Bucharest and Prague-Berlin runs, and more are now being constructed for the main European air-lines.

SPECIFICATIONS.

Length	35¼ feet
Height	11½ feet
Wing spread	50 feet
Motors—	
3 Avia R 12 radial	200 hp. each

PERFORMANCE.

Maximum speed	163 m.p.h.
Cruising speed	142 m.p.h.
Ceiling (service)	14,000 feet
Landing speed	62 m.p.h.
Radius of action	500 miles

The small wing-spread is particularly notable and while the landing speed is rather high, they have proved handy ships in service, thanks to the excellent braking system. They have proved capable of crossing the mountains, with which Czechslovakia is shut in on all sides, on two motors and with a full service load.

END.

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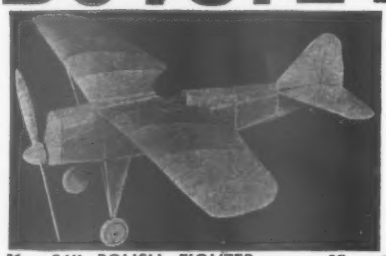

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1933 Waco C
¾" scale. America's prize cabin biplane. Span 24¾", length 18¼", weight 3.7 oz. Silver and red. COMPLETE Kit SF-37, now ONLY..... **$2.75**

Bubble Sextant

(*Continued from page* 298)

get the necessary direction and information for continuing their voyage to Tahiti.

Here, let it be explained, dependent upon the season and the latitude, the prevailing winds were from the southeast in the vicinity of Tahiti, hauling by degrees to approximately northeast when in the latitude of Hawaii. And, while it is true that these winds are neither steady in direction nor constant in force, they are, nevertheless, the prevailing winds.

Having this information, the crew was directed to put their canoe on the starboard tack and keep the wind abeam or a little forward of the beam. This, in plain English, means that in the long run their average course would carry them several hundred miles, at least, to windward and to the eastward of Hawaii.

They were also aware that, when approximately half way back on their return journey, which would be in the neighborhood of a little to the northward of the equator, they would raise the North Star, and from that time on they were to give heed to the Sacred Calabash.

Now, as to the Calabash itself.

It is a species of gourd over three feet in length, the bottom spherical, the barrel cylindrical and slightly tapering toward the top. Near the top, a row of four holes had been bored on a circle (around the circumference) 90° apart, whose plane was at right angles to the longitudinal axis.

As they gained latitude to the northward, the Calabash was to be filled with water up to the holes and through any one of the holes (and over the opposite upper rim of the Calabash), observations were to be made on the North Star, until, still observing through the hole, it became tangent to the upper rim. When this condition obtained, the course was to be immediately changed to west. This westerly course would be altered from time to time if necessary, so that Polaris would remain approximately tangent, thus insuring their keeping in the approximate latitude of Hawaii and arriving at that island in due course.

As a matter of fact, although crude, this method of making the return voyage, and particularly the use of the Calabash for finding Hawaii, is not only based on scientific principle, but it is practically, in a modified way, one of the most general methods of finding latitude today by the North Star. In fact, a sextant may be used on the same general principle involved if it be set at a constant angle and used in the same way.

Naturally, my curiosity was aroused to see this so-called "Sacred Calabash," and to ascertain if it could be reliably used for its reputed purpose.

Obtaining permission, I filled it with water to the circle of the holes and measured the angle from any one of them across to the opposite rim, and found it to be about 19°. The water inside acted as a level, keeping the Calabash in the vertical.

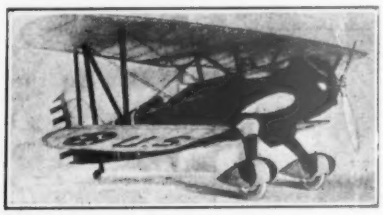
Thus, when Polaris was on the rim, its altitude was about 19°, which roughly equalled the latitude of Hawaii, and enabled the crew to steer west with a confidence that they would reach their destination.

It seems all but needless to call attention to the fact that the altitude of Polaris varies about two degrees each day, but it is equally evident that if several days were consumed in the western part of the voyage, or if when on shore more careful observations had been taken of Polaris, this change would have become known and allowances made accordingly. At any rate, the natives repeatedly make this trip without difficulty.

From the foregoing you can see that latitude is easily procurable with a sextant and Polaris the only observed body. In using any other body as the observed, it is necessary to work a line of position which by the very easiest method is an elaborate mathematical problem.

END.

Curtiss Army Hawk P6E



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The strongest and most perfect model of the P6E on the market, has squadron insignia on pants and fuselage, metal exhaust pipes, aluminum wheels, 2 color dopes, all parts printed on balsa, printed instrument board, semi scale, Fibre prop. **Const. Set Complete, Postpaid $2.50**
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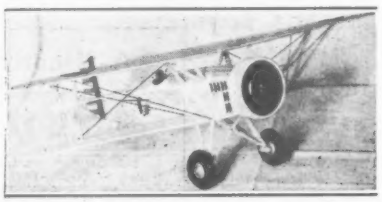
Curtiss Sea Hawk P3A



24″ Span, Weight 1¾ oz., Flies 900 Feet
Set includes 3″ celluloid motor, aluminum motor plate and drag ring, balloon celluloid wheels with plate discs, printed instrument board, fuselage, wing and rudder insignia, aluminum pilot's seat, dope, glue, drawing and all materials. **Const. Set..... $2.50**

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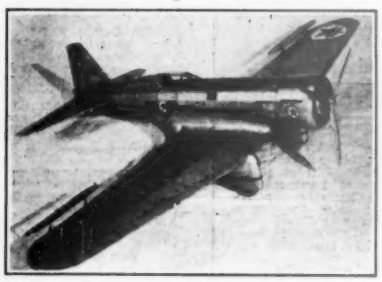
Northrop Gamma



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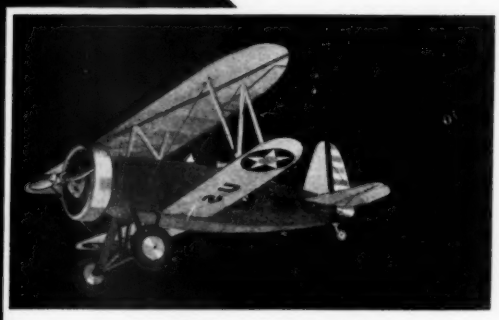

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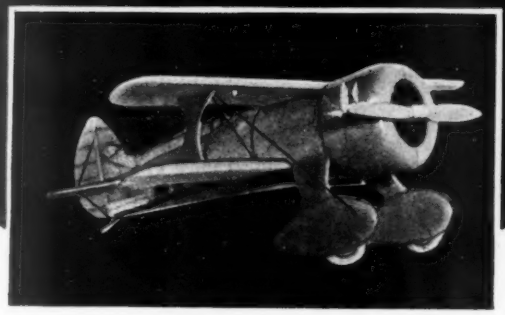

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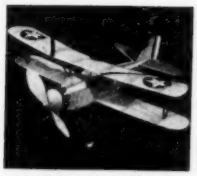

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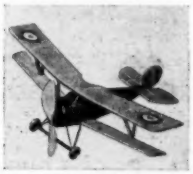

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Engine Quiz

(Continued from page 311)

exhaust is cooled down to 100°F., then it can be proved that the heat efficiency is 53.7 percent., or higher than the efficiency of the best Diesel engine built.

Q. You say that this can be proved; please prove it.

A. *The thermal efficiency of any kind of heat engine (E), is shown by the following equation in which (T) is the high temperature of the gases or steam at the beginning of the stroke and (t) is the temperature of the rejected or exhaust gases. These temperatures are "absolute" temperatures obtained by adding 460°F. to the thermometer temperature.*

$$E = \frac{T - t}{T}$$

In the given problem, the boiler steam temperature is 600°F. to which 150°F. superheat is added making a total live steam temperature of 750°F. Adding 460°F. to this, to get the absolute temperature gives 1210°F. absolute. To the exhaust temperature of 100°F. we also add 460 to get the absolute temperature, so the exhaust is 560°F. absolute.

$$E = \frac{T - t}{T} = \frac{1210 - 560}{1210} =$$

0.537 or 53.7 percent.

This is the heat or thermal efficiency and does not take frictional losses into account.

Q. What do you mean by absolute temperature?

A. *The absolute temperature is the point at which heat is "zero" or ceases to exist. This is 460°F. below the zero on the Fahrenheit thermometer or 273°C. below the zero on the Centigrade scale.*

Q. Having obtained the thermal efficiency as above, just what does this percentage mean?

A. *The efficiency is the ratio of the energy given out by the engine to the heat energy received from the fuel. In other words, if an engine converts half of the energy received in the form of heat into mechanical energy available at the shaft, then its efficiency is said to be 50 percent. The over-all efficiency considers all losses, including bearing friction, piston friction, windage, etc.*

Q. Is there a science of calculating heat problems and heat energy?

A. *Yes. This is the science of Thermodynamics under which the study of heat engines is taken up.*

Internal Combustion Engines

Q. Please describe how the fuel is burned in a gasoline aviation engine.

A. *The liquid fuel is first sprayed and mixed with the proper proportion of air to burn it and is then vaporized in the carbureter. The piston moving down on the suction stroke, draws this combustible mixture into the cylinder. Then, on the outer stroke of the piston, the mixture is compressed and at the end of the compression stroke, the mixture is ignited by an electric spark.*

The heat produced by the combustion expands the gases and the pressure produced, drives the piston on the working stroke. The exhaust valve now opens, allowing the exhaust gases to escape, while the upward motion of the piston cleans out the remaining gases. The latter is the "scavenging stroke."

Q. What sort of gasoline engine is this?

A. *This is called the "four-cycle engine," or more properly, the four-stroke-cycle engine since four complete strokes are required to complete the series of operations. This is the most commonly used type of engine.*

Q. Please name the operations once more in shorter form that take place in the four-stroke-cycle engine.

A. *There are five operations or "events" in the four-stroke cycle. One. Suction stroke. Two. Compression. Three. Ignition. Four. Working or power stroke. Five. Expulsion or scavenging stroke.*

Q. Then there is only one working stroke out of four?

A. *Yes, there is only one working stroke or power stroke out of four strokes, or, one power stroke every other revolution for each cylinder. The action is intermittent.*

Q. What keeps the engine going during the three strokes lying between the power strokes?

A. *The momentum of the propeller acts like a flywheel. The propeller (or flywheel) stores up the energy of the working stroke and distributes it during the remaining three strokes. Instead of giving out power, power is actually absorbed during the compression stroke.*

END.

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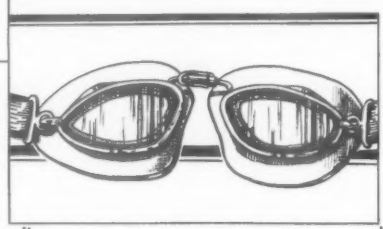

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Engines

(*Continued from page* 302)

The horizontal arrangement of four cylinders may give slightly better forward visibility than an upright in-line engine, but it obstructs some of the view each side of center. It obviously is inferior to an inverted in-line type in all respects as far as visibility to the pilot is concerned. Compared with a radial type, the flat four permits better vision directly forward, but in most instances contributes little toward the space needed for vision at the sides.

It is reasonable to assume that an engine with eight cylinders in horizontal arrangement should weigh about the same as one in Vee formation. However, with all things being equal, it is difficult to see how it would be possible to build such an engine of less weight than a seven or nine cylinder radial of equal piston displacement.

In some respects, the cooling problem in the opposed eight is similar to that in an in-line or Vee type with four cylinders in a row, yet it may be possible to effect some improvements as a result of the horizontal position of the cylinders. Under no circumstances, however, could it be assumed that the problem is as simple as cooling a radial type of seven or nine cylinders of approximately the same total displacement.

If we might be bold enough to imagine frontal area a reliable index to head resistance, the eight-cylinder horizontally-opposed engine should compare equally well to the Vee type of eight cylinders, and offer less resistance than engines of equal displacement built with seven or nine cylinders in radial form. But we know that the drag cannot be predetermined in this manner, so we cannot hope for much gain even though such an arrangement may present some opportunities for cowling and air circulation which are not possible in the Vee forms.

The visibility with the horizontal eight-cylinder engine is slightly inferior to the inverted Vee type, but not much worse if the latter is installed in an upright position. Obviously, greater forward vision is possible with the flat engine than with a corresponding radial type, but in taking into account the region at the sides, it cannot be greatly superior in this respect due to its increased length.

The comparisons, which have just been drawn between the features of the eight-cylinder horizontally-opposed form and other types of corresponding output, might apply equally well if the opposed twelve-cylinder engine were being considered. It would be necessary, of course, to take into account its greater length, and determine how much this would affect the relative weight, drag and visibility, as well as the problem of cooling.

Granting that the opposed twelve offers the most ideal cylinder and crank combination in the horizontal forms, it apparently presents a more difficult installation problem, and possibly to such an extent that it may hinder its acceptance in certain instances.

The flat form of the types under consideration makes them ideally suited for mounting near or inside the leading edge of thick wings. It is known that this idea was first taken under consideration over ten years ago, but for some inexplainable reason, it has never been carried out with serious intent. The merits of the scheme remain unchanged, and perhaps would be given a fair trial once suitable engines were available. These engines, in many cases, should be liquid cooled, but that detracts little, if any, from the installation features which the scheme enfolds.

Our purpose has been to determine why engine designers have so noticeably neglected aircraft powerplants of this class, and the reasons for some airplane designers seemingly favoring such engine forms, but lacking the courage to lend substantial support to their ideas. It is not expected that we have presented all the answers, but let us draw what concluding information we can from the discussion.

It would be necessary to survey the entire history of horizontal engine development to bring out the engine builder's attitude toward this type,

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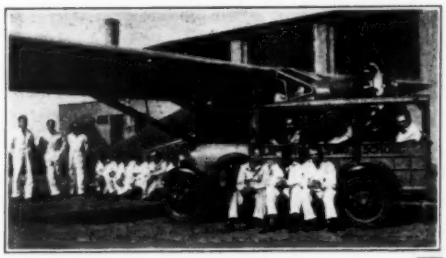

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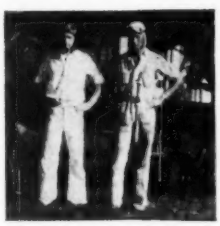

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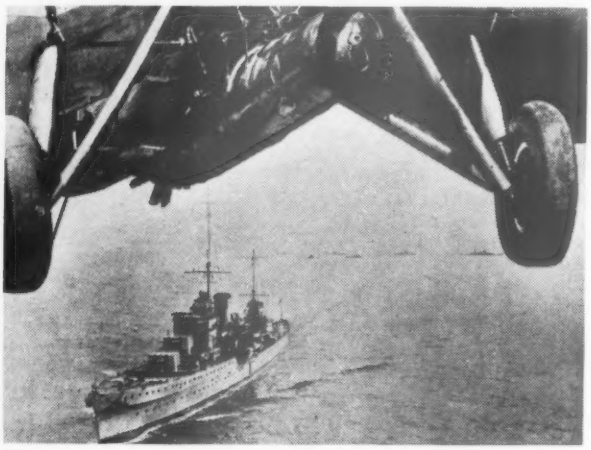
which the present circumstances hardly justify. However, it can be readily understood how quickly one's enthusiasm for his product might be dampened if he elected to construct an engine according to some of the unfavorable arrangements described earlier in this discussion.

Perhaps the engine designer has heretofore given insufficient study to the kinematics of this problem, and thereby reflected an unfavorable light on all power units of this form. It is perhaps nearer to the real or more important facts to state that suitable engines of this class will undoubtedly be made available whenever the demand is clearly and convincingly presented.

The airplane designer desires an engine which incorporates the best features of all types, but such a large order is impossible of fulfillment at the present time. Is it not a more rational plan to evaluate the features which each type possesses, and select the one which offers the greater possibilities? If the horizontal engine is the one selected, then the engine designer can go to work on the less favorable features inherent in this particular type, and possibly bring out a product approaching the ideal for the special purposes for which it is intended.

END.



COMING FROM OVERSEAS

WE KNOW that you'll be interested in the June issue of POPULAR AVIATION because this issue will contain some unusual features—many of them obtained from abroad.

This is rather indicated at the very beginning, for the cover picture and the model—both—will be reproductions of the world famed "Hawker Super-Fury," the fastest pursuit ship in the world. And then, throughout the issue, will be interesting articles and pictures of the latest developments in Europe of which there are many.

But—this issue will not be an exclusively European issue for there will be a number of new American planes described. And two of the American ships will be knockouts, the automatically stable self-flying monoplane and the brand new Nemeth creation which has just been flown in Chicago.

WATCH FOR THE JUNE ISSUE

On Sale May 10th

Philanthropy

(*Continued from page* 294)

an unsympathetic mob of fellow citizens.

Well, then, let's forget the personalities for the time being and see how things could be made to pay if the public could be educated into the idea of supporting an airport. If they could be made more tolerant toward the situation, less critical of those in charge and more honest in their attitude, is there any way of financing the maintenance of the airport?

Yes. An airport could be made to pay by interesting each individual in the airport, making him understand that it is of as much interest and profit to him as anyone else. He will support it if the management makes the airport so interesting to him that he will drive out occasionally, paying a small admission or parking fee and patronizing the various concessions. He can be taught to dine at the field restaurant, to take a few rides, to buy his gasoline at the field pumps when he is passing by, to attend benefit minstrel shows put on by local talent or to patronize an air-express service or passenger carrying service operated by the airport. Hangar rental, flight instruction and service charges on airplane repairs, are of course, another conventional source of revenue. But no air-shows.

I have seen the air-show and air-circus idea tried out at dozens of small airports but it is always a losing proposition because of the greediness of the people. They will allow you to give them free entertainment but they'll not spend a cent if they can avoid it. And after watching the events from the outside of the fence, they will have the nerve to come to you and complain that the show was no good and a disgrace to the community. Then, after dodging payment of a 25 cent admission fee to a show that has held them spellbound all afternoon, they'll take the whole family to a movie that lasts one hour and costs them from fifty cents to five dollars.

After 30 years of aviation, and with the aeronautic industry developing all around them, these people still have to be educated in the support of flying. Further, they must first be educated in a sense of fairness and sincerity in their pride of local achievement. If they are really interested in aviation (as they profess) and are not simply posing as exponents of the big idea, then there is some hope for them.

And so, you pilots and airport managers, forget the show idea. Save your money, gasoline and ships and don't allow the mob to cut up the turf with their cars nor allow them to tear down your fences. It takes a born air-showman to put on an air-show and get anything out of it, and even the born and bred showman doesn't always get away with it either.

END.

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Good Opportunities for Our Swappers

The publishers reserve the right to reject any or all notices that are not in accord with the policy of this magazine. Only trades or "swaps" will be permitted. For cash deals, buying or selling, refer to our Buyer's Directory. Readers are urged to use caution in arranging trades and references should be mutually exchanged.

AIRPLANES

WHAT am I offered cash or trade for OX5 Swallow, good shape, now flying; OX5 Curtiss Robin, also in good flying condition; pair of uncovered Heath wings; pair of Duraluminum monoplane wings, 5'x14" each; inquiries invited.—Whitewater Aviation Club, Whitewater, Wis.

AIRPLANE WANTED. Preferably lightplane, Heath or Aeronca. Crackup considered if not bad. Will trade Conn & Alto Saxophone (silver and gold) like new. Savage Sporter 25:20 rifle and give $25.00 cash.—Frank Howard, East Palestine, Ohio.

SWAP: Combination Eaglerock crackup. Needs lower wing panels, landing gear crippled. Otherwise O.K. OXX6, two Scintillas. 8:50-10 airwheels, instruments. Also Colts .22 cal. Police Positive revolver. Ostgies .32 automatic. Crosley A.C. radio. Want licensable lightplane, cabin cruiser, glider, Eaglerock parts.—John F. Brock, Spencer, N. Y.

WANTED 3-cyl. Anzani or Czekely. Have air wheels, 500x4, cast aluminum, new. Used tire and tubes, best condition.—H. A. Tice, 14906 Elm Ave., Cleveland, Ohio.

THEATRE Equipment—Seats, Machines, Sound Equipment, trade for airplane, merry-go-'round, wheel or rides.—R. D. Troutman, Standish, Mo.

HAVE A-1 Henderson and prop., also chassis for midget front wheel drive car. Want Harlequin or like motor. Will add cash or buy outright.—E. W. Young, 823 Rockton Ave., Rockford, Ill.

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WANTED: Any plane in flying or cracked condition, aeroplane motor with prop, under 100 H.P., and 1930 Harley 74" motor. Will give cash or trade the following: 2 ¼ H.P. A.C. motors, battery charger less bulb, 44-40 carbine rifle and .32 S. & W. revolver; 4 H.P. outboard motor, 1929 74" Indian and Harley cycles, motorcycle parts, tires, wheels, all sizes. Everything in A-1 condition.—Mish Britt Cycle Co., 25 Underhill St., Winthrop, Mass.

TWO splendid Johnson outboards, 32 and 16 H.P., with cash, for licensed two-place plane or good aircooled motor, 35 to 90 H.P. Have steel tubing, any welded parts desired, wings, tail surfaces, motor mounts, exhaust stacks to sell or trade for anything valuable. Want Aeronca propeller.—McCoy's Aircraft Service, Nepoleon, Ohio.

HAVE 80 acres of good land, near Longeville, Minn. Want a licensed Waco, Aeronca, Travel-air Commandaire or what have you?—J. T. Bilben, Walker, Minn.

NEW AMERICAN EAGLE 3-place plane, never flown, cost more than $3000.00; will trade for 1934 Ford V8 sedan or coupe or late model light car and $200.00 in cash. Real sacrifice. Have also some airplane and engine parts. Write your proposition, enclose stamp. — Fonell, 430 N.W. 25th Ave., Miami, Florida.

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WANT—Light automobile and $150 for 3-place airplane developed and flying all last summer, fine performance. Could be placed on market for $975 with 110 H.P. motor. Also on hand 2 rebuilt "A" Ford motors. OX5 motor, 4 compasses, 2 tachometers, 3 air-speed indicators, 6 Hydraulic Shock Absorbers, Waco 9 frame.—Geo. F. Bischoff, 1520 Vickery Blvd., Fort Worth, Texas.

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HAVE Pietenpol Camper to trade on small licensable ship or sell for $200.—Lester A. Simon, 316 Tyler Ave., Ridgway, Penn.

WILL TRADE for lightplane, practically new Ideal Lawnmower Sharpener with straight blade, grinding attachment.—Walter Smith, 223 Franklin Ave., Sioux Falls, S. D.

WANT OX5 Biplane. Need not be licensed. Have 1927 Whippet Coach in good condition. Add cash within limits.—Richard Shoun, Milesville, S. D.

WANTED: Two-place licensed lightplane, good condition. Trade 1929 Ford coach, new car condition, with extras. Add cash if worth it.—Herman Montney, Fryburgh, Penn.

LICENSED Waco 10—OX5—Latest GXE Model. Steel prop., new DH wheels. Millerized. Wings recovered, fuselage factory covering. Duals. Perfect condition. Make cash offer or trade for aircooled ship.—Merle Zuehlke, Box 282, Watertown, Wisconsin.

LIGHTPLANE WANTED. A Heath Parasol preferred, but any reasonably good ship considered. Have a dandy Harley-Davidson motorcycle. Photo and details of motorcycle free.—Clarence W. Trost, Rice, Kansas.

MECHANIC'S LICENSE WANTED. Young man will exchange work for instruction in aircraft mechanics and living wages, or equivalent. Experienced in welding, tinshop, auto-repairing and some aviation. Will go anywhere.—Rudolph Raspet, Bridgeville, Pa.

WANTED. Two-place licensed lightplane, good condition. Will trade 1929 Ford coach, new car condition, with extras. Will add cash if worth it.—Herman Montney, Fryburgh, Pa. (2)

ELIAS MONOPLANE, Experimental, less motor. It is a 2-place side-by-side type, convertable coupe, chrome-tubing construction, oleo landing gear, weight 650 pounds. Will swap for OX5 engine and some cash, or what have you?—John F. Kane, Center Road, Gardenville, New York.

CHURCH MIDWING MONOPLANE, new factory welded fuselage, complete but uncovered. Welded steel empennage, undercarriage, motor mount, fairings, instruments, controls, etc. Paid $185 for it and has never been used. Also wings, complete with controls and tanks but uncovered. Plane complete otherwise, minus motor and covering. Also 5-gals. of dope (gray) including blueprints. Good bargain for a reasonable trade. What have you? 4-cyl. late model motorcycle preferred, with side-car, or Chevvy coupe.—Ed Hartinger, Litchfield, Minn.

BUHL BULL-PUP, 1931, less than 75 hours. Szekely 45 h.p. engine, speed-wing. Will trade for 1933 Ford V-8 coach or will sell for $395.00. Also will accept light aircraft and cash.—L. J. Perry, Harley-Davidson Sales and Service, Kalamazoo, Mich.

LAWRANCE ENGINE complete with prop, three hours time. Will take $60.00 or will accept trades in light aircraft.L. J. Perry, Harley-Davidson Sales and Service, Kalamazoo, Mich.

WANTED. A 3-place OX5 plane. Have dope and other things to trade with some cash. Must be licensed or eligible for a license. All letters answered.—Z. Sajkowicz, Jr., 22 Howard St., Norwich, Conn.

ENGINES AND ACCESSORIES

ONE baby Overland engine, complete with starter, generator and trans., in good shape. One model "A" Ford engine ready for converting for air camper, will trade for Lawrence two-cyl. motor or two-cyl. Harlequin.—J. C. Marsh, 1721 N.W. 16th St., Oklahoma City, Okla.

NEW Indian generator and speedometer. What's your offer?—Hugh McDaniel, R. 1, Itasca, Texas.

WANTED—Overhead valve system (16 valves) with down-draft carburetor for model "A" Ford. Increases power tremendously. — Edward C. Welbert, Jr., Narrowsburg, N. Y.

WELDING torch, Smith, standard size, with tip assortment. Want light airplane welding torch. —J. E. Williams, care of Popular Aviation.

WILL EXCHANGE Aviation Instruments and timepieces against air mail stamps and flown covers of better grade. Send list only to A. Burkhardt, Room 1207, 299 Madison Ave., New York.

HAVE a pair of Heath wings and tail group and glider; will trade for motorcycle, typewriter or what have you?—Cecil Hartley, Talent, Oregon.

TRADE outboard racing boat and motor for sportplane motor or motorcycle.—Eugene Roderborn, 1026 2nd Ave., S., Fort Dodge, Ia.

GRAY "Phantom Four" 55 H.P. inboard marine motor wanted. Will trade even, and 3-cylinder 65 H.P. radial aircooled airplane motor. Motor in A-1 shape.—C. W. Wilson, 113 N. 14th Ave., Hopewell, Va.

WOULD LIKE 60 or 80 H.P. aircooled motor with prop or without. Any make. Please answer soon. The motor must be in running condition. Complete. I have in exchange a new Remington Automatic 30 cal. rifle, checkered stock and forearm grip.—Gus Heim, Sunset Inn, Center Lovell, Maine.

WANTED—Harley "74" motor for 1927 motorcycle.—Stuart Schuyler, R.R. 1, North Judson, Ind.

TRADE—Partially completed four-in-line aircooled airplane motor using aluminum auto crank case and LeRhone cylinders, will develop fifty horsepower; also plans for practical portable arc-welder. Will trade for sporting goods.—Fred W. Mohr, Riceville, Iowa.

GLIDERS

WILL TRADE or sell: Primary glider, less wires, cables and coverings. Six-ft. celestial refracting telescope complete with equatorial mounting.—Charles J. Conrad, R.R. No. 2, Oxford, Ohio.

MISCELLANEOUS

I HAVE the following things to swap: Two lots at North Wales Park, near Philadelphia. One lot at Thornhurst in the Pocono Mts. Clear deeds to both. Remington No. 6 typewriter, new jig saw, Hinton Aviation course, set of drums, tenor guitar and magicians tricks. What am I offered in the way of cash, airplanes, automobiles or what have you?—Wm. Jeffries, 30 John St., Sheatown, Nanticoke, Pa.

MOVING picture films, camera, books, etc. Want a stamp collection or what have you?—Jack H. Merrill, Morris Plains, N. J.

(Concluded on next page)

Barter & Exchange

(*Continued from page 339*)

HAVE 17-J. wristwatch, field glasses, guitar, telescope, etc., and some cash. Want typewriter or .22 target pistols.—Geo. Dubek, 81 Chestnut St., Garfield, N. J.

WANTED to exchange: Brand new genuine leather helmet and new non-shatterable goggles. What am I offered?—Frank Bidwell, Jr., 1035 Fulton St., Palo Alto, Calif.

TRADE for anything: 13 back numbers Popular Mechanics, 9 National Geographics and Home Builders Catalog for 1929, then priced at $10.—John Elliott, 1116 Bingham, Sault Ste. Marie, Mich.

WANTED—December, 1930, April, May, July, November, 1931, Flying Aces. Also October, 1931, Sky Birds.—Stephen Melnyk, 160 Isabell St., Johnson City, N. Y.

WANTED—To exchange, World War Aircraft relics and photos.—Wm. J. Boylhart, 86 Huron Road, Bellerose, L. I., N. Y.

AMBITIOUS young man of 19 willing to work hard anywhere, in exchange for board and flying instructions and further advancement. Am 5.3 tall—115 lbs.—Not much, in a way, but "buzzards," just give me a chance.—A. J. Russo, Winnmere Ave., Burlington, Mass.

YOUNG man of 19 (high school graduate), will do anything honorable in exchange for aviation training and flying instruction. Have had preliminary training. Can furnish best of references.—Kenneth R. Drew, Route No. 1, Junction City, Oregon.

WANTED — English Riding Boots, size 10½. Will trade Hampden watch, 17-jewel.—Orville Bolstad, Northwood, N. D.

I WILL TRADE 9 issues of Aero Digest, April to December, 1932, inclusive, for Cleveland model plans.—J. Dettis, 544 Bellanca Ave., Pittsburgh, Pa.

WELDING TORCH, Smith, standard size with tip assortment. Want light airplane welding torch.—J. E. Williams, Y. M. C. A., Charles City, Iowa.

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Send for folder.

Gen. Foulois

(*Continued from page 292*)

strategic value. Such a profound work had never been seen before by the Washington military graybeards. And it was profound, too, as other flying men will tell you today.

The military moguls were vastly impressed and ordered the youngster to the capital for duty with the Signal Corps. The famous contract with Orville and Wilbur Wright had been drawn up and the Army possessed a flying machine to study and test and, as Benny himself puts it "to fool around with."

Lieuts. Humphries and Lahm were assigned, with Foulois, to be the principal actors in this "fooling around" process. Then, the War Department transferred the former two officers to other duties and told Foulois to take the Army's Pride-and-Joy, the Wright biplane, to Texas for further experimentation.

So Foulois went to Texas as the United States Army air force! He had had exactly an hour and a half to his credit in flying time—and that as a passenger observing the intricate method of operating a flying machine. But orders were orders. Benny built himself a hangar on the Texas desert and resolutely, if gingerly, took his plane aloft for a trial spin.

There were so many difficulties, especially after a crackup, that he concluded the best way of getting to know these contraptions was to ask the Wright brothers. After all, it was their idea and they ought to know something about it.

That's the origin of the story that Benny Foulois learned to fly by taking correspondence courses. Which is, of course, just what he did. After each voluminous report from Dayton, where the brothers were busy building more planes, Benny patiently wheeled his ship out on the sand dune and applied the principles being written to him. The Wrights left nothing to chance in their explanations; the result was that Benny Foulois became a pilot of no mean ability.

He is among the few pilots that have no superstitions. Lighting three cigarettes on a match holds no terrors for him. He explains that, back in the days when he was busy fighting the Moros, he learned that they had a saying that "what will be, will be." This, he explains, was a great factor in his life. It prepared him with a ready-made but highly effective philosophy that has prepared him for his life's work more than any other teaching he has run across. He does not believe in too much discussion of accidents in flying. Not that this a superstition, he explains. It is simply not conductive to the highest morale and courage so necessary in flying.

Although he is abstemious in his personal habits, there is one notable exception. His pipe. It is always with him. He doesn't smoke in planes because the Air Corps does not encourage its pilots to do so, even in fireproof ones. But he isn't on the ground five minutes before he has his old briar brewing a cloud of invigorating smoke.

He doesn't even have to fish around in his clothes for it. He usually carries it in his mouth while flying and the harder the flying, the harder he bites it. He doesn't know how many pipes he uses up in a year. But he prefers gnawing on the briar stem to chewing gum while up in the clouds, although he admits he occasionally changes—but only for an hour or two.

The day that Wilbur Wright met Foulois the latter was, as usual, emitting great clouds of smoke from his pipe. Everyplace he went the pipe went along, protruding from its owner's lips at a rakish angle. Finally the great pioneer turned to a group of government officials and army officers acompanying the two on the inspection tour, and remarked:

"A man who smokes a pipe like Foulois does, will never make a flyer."

There is a twinkle in Benny's eyes as he tells this.

This mild mannered, blue-eyed, diminutive Chief of the Air Corps, its celebrated Flying General—perhaps one of the first in history—doesn't look much like a daredevil. But then what daredevil — except Roscoe Turner — does?

END.

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Airy Chat

(*Continued from page 286*)

WE have had so many demands for the address of an engine builder who produces a low-priced 50 h.p. lightplane engine that we heartily wish such a man or company will show up at an early date.

* * *

A BIG argument was started the other day in our office by an old-timer and a new-comer on the threadbare subject of pusher engines versus tractor engines. Said the new-comer, "Yes, but then there is always the danger of having the pusher-engine falling down on your neck." Said the old-timer, "Mebbe so, but I just as soon have a pusher engine on my neck as a tractor engine in my lap," and so the matter ended. What is your preference?

* * *

JUST across the alley from my home is a spotted pointer dog. This dog specializes, much to everyone's amuse-

ment, in pointing airplanes out, low flying airplanes that pass too close to the house. Let a low flying airplane come along and then the dog snaps into a picturesque "point," with head and tail rigidly extended and one leg lifted, just as if he were calling his master's attention to quail or a pheasant. This dog should be enlisted by the Department of Commerce as a special investigator on low flying planes.

* * *

WE cannot help but think, getting back to that army airmail subject, that the Army Air Corps' age regulations are a bit off the track. Most of the pilots delegated to flying the mail were very, very young—fledglings so to speak—and it was proved conclusively that youth alone cannot take the place of long experience.

* * *

WE have often wondered why more of our model builders have not taken up with that fascinating pastime—the flying of scientific kites. There is still much to be learned about kites and they undoubtedly will, at some time, be usefully applied to various purposes. Lawrence Hargrave did much original research work on kites and it would be interesting and useful for our modelists to study his developments which just preceded the airplane.

* * *

AERONAUTICAL engineers have long understood the difficulties encountered in properly strengthening the tail-group assemblies on transport planes. The stresses on the fuselage at the point near the tail-group are tremendous and many of the recent accidents to transport ships can be traced to this trouble. The tendency toward tail-flutter is unusually marked with the large ships and this is probably one of the reasons why the designers of the Lockheed "Electra" elevated the tail so that it was at least partly out of the slipstream field.

* * *

FOR those of our readers who are saving the data sheets, we have a word that will be of interest. We are investigating the subject of binders for these sheets and when we have arrived at a decision as to what class of cover will be most suitable for the purpose, we will pass the word to you. The difficulty with this job is to find a cover that is at once reasonable in price, of attractive appearance and handy to manipulate when filing the sheets.

* * *

WE have had so many letters from our readers who wish to learn all of the details for getting a license, wither for themselves or their ship, that I will refer them directly to the only authoritative source of information. Write to the Department of Commerce, Aeronautics Branch, Washington, D. C., for Bulletin No. 7, Air Regulations. This will save us both a delay.

* * *

I'll see you at the same place next month.

J. B. R.

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PROPELLERS—Ford A 6' diam. $8.00; H.D. 4' diam. $3.50; Henderson, $5.00; Szekley 45, $10.00; Continental, $8.00; Harlequin, $6.00; 4 bladed, 4' diam. Ford A $10.00
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Racing Rules

(*Continued from page* 296)

not fly toward, over nor within 500 feet of grand stands or spectators. No objects shall be dropped so that they will fall within 500 feet of grand stands or spectators. Home stretches of race courses are to be laid out so that they will parallel grand stands or other space reserved for spectators. The home pylon is to be located at least 800 feet from grand stands or spectators.

Racing pilots are required to stay at least 50 feet apart and an overtaking pilot must be 150 feet ahead of the plane overtaken before cutting in ahead of it. Race horse starts are prohibited, except in cases where the entrants can line up with at least 100 feet between airplanes, and when the first pylon is a scattering pylon, which will draw the racing craft apart from each other. Many accidents have resulted from race-horse starts in the past and it is hoped that this will be an improvement.

Other rules define the responsibility of the air meet or race management with respect to compliance with Air Commerce Regulations and other requirements, for policing of the airport, for marking the area which may be used by spectators and that reserved for participating aircraft.

END

Bellanca

(*Continued from page* 319)

mented to tops of lower balsa curved parts on wheel coverings.

The tail-wheel is very simple to construct, having a short strut on either side of wheel which is cemented to rear bottom of fuselage.

CONSTRUCTION OF WING

Cut all ribs from 1/32 inch sheet balsa. Lay a sheet of wax paper on the plan and pin leading and trailing edges and center spar in position. The ribs are now placed in an upright position in their proper locations and cemented.

Make wing tips as shown on plan. We recommend this type of wing tip, as it is far simpler to construct and neater in appearance.

The ailerons are now built into the panels. Ailerons will eliminate the need for building "wash-in" into wing. We recommend that you build your model with all movable controls, as you will need these to control your model under flight. Cover wing with tissue making sure all wrinkles have been stretched out of the surface. Cover ailerons separately.

TAIL GROUP

This is made entirely of balsa and is constructed upon the plan. Cover each part separately with tissue in much the same manner as the wing. Aluminum hinges are cemented into position after framework has been completely covered so that the tissue will be taut. When thoroughly dry give a coat of dope.

FINAL ASSEMBLY

The finish on the parts of the model, such as all exposed balsa parts, etc., can be greatly improved by giving them three to four coats of banana liquid, so that they will have a smooth and glossy finish. Where the wings meet at the top of fuselage, it is necessary to make two balsa fairings which finish off the wings at top of body. All other struts are now cemented in their proper locations.

PROPELLER

Many model builders require two types of propellers. One for flying and one for display purposes. We have correctly shown on the plan how to construct both of these types. The flying propeller is very simple to construct.

A propeller with a broader face than the scale propeller is necessary in order to contact a sufficient amount of air to drive the model and to hold down the speed of the rubber motor. Another important item is the bearing which must allow the propeller shaft to turn freely and yet must be tight enough to prevent "wabbling" or vibration.

FLYING THE MODEL

Where possible, it is best to give the model a gliding test over tall weeds before attempting to fly it with the motor. When properly balanced, it should glide steadily without diving or stalling.

END

The Hawks

(*Continued from page* 290)

It might be appropriate at this point to mention the only other major change in the F6 series, the XFC-6, which was flown by Capt. Page to his death at the 1930 National Air Races. This plane, which is fairly well known to most collectors, was a stripped down F6 fighter which had been powered with an 800 h.p. supercharged Conqueror motor. He had removed the lower wing, rebraced the upper wing and installed one of the first of the single strut landing gears. The top speed was not definitely known but was estimated at 300 m.p.h.

After such a busy year in 1928 and 1929, The Curtiss Corporation let the Hawk models rest during 1929. Only one new model, the P-1C (already mentioned) was introduced and a few were built.

Their redesigned P-6 was accepted in 1930 and they filled an order for eighteen. They, also, presented several variations of the P-6 series, amongst them: the P-6A, the P-6B, and the P-6S. And another experimental air cooled model, the YP-20.

The P-6A was similar to the P-6 but used a chemically-cooled Conqueror motor. The P-6B and P-6A were similar in appearance but the P-6B was powered with a D-12 motor.

It is probable that the P-6B is the least known of the Hawk planes. In fact, it was only about three months ago that I was even aware of its existance. And as yet I have very little information about it. I might add here that that is one of the joys of scrapbook collecting, we are invariably finding something new and interesting.

The P-6S is another plane about which I know very little. I believe only three of the planes were built, which were sold to the Cuban government. They were similar to the P-6 but powered with a supercharged Wasp air-cooled motor. The YP-20 was an experimental model built around the 575 h.p. Wright Cyclone motor. It was equipped with wheel pants, a drag ring, all the latest streamline improvements and showed a high speed of 193 miles an hour. The "Y" shows that it reached the service test stages but so far as I know it never passed that stage. However, the F11-C's and the Curtiss Turkish Hawk were developments of this plane. But more about that later.

During 1931, '32, and '33, continued development of the P-6 and the YP-20 types were made. They introduced the XP-22 in 1931. It was accepted as the P-6E in 1932 and at the present time is one of the standard pursuit planes of the Army, but not likely to remain as such much longer. The P-6E was similar to the other P-6 planes but was built around a 650 h.p. Curtiss chemical cooled conqueror. It had several new streamline improvements, including the new single strut landing gear, wheel pants, and considerable change in the nose lines. It was the second (the first to be ordered in large quantities) of the Hawk planes to show a top speed of over 200 miles an hour, its top speed being about 204 m.p.h. Just recently a new P6 model, the P-6F, has been introduced. It is about the same as the P-6E except for a coupe top similar to the tops on the Curtiss Swift.

Since about 1929 the Navy has used as standard fighting planes, the F7C and F8C types. But they are now returning to the Hawk type and are beginning to use the F11C-2. The F11C-2 is undoubtedly the most popular of the air cooled Hawks. Over a hundred planes of this type have been built and sold to various governments and individuals within the last year.

What is now known as the F11C-2 first made its appearance in 1932 when an order was filled for the Turkish Government. This plane, which came to be called the Curtiss Turkish Hawk, was similar to the YP-20 in most respects but was powered with a 700 h.p. Wright Cyclone motor. Its performance is still secret but the top speed is rumored to be well over 200 m.p.h.

The advent of the Boeing and Martin Bombers in 1932 made obsolete all existing pursuit planes and caused the Army to issue calls for high speed planes of the intercepter type, having a high climbing rate and a high speed of 250 m.p.h. or over.

The Curtiss-Aeroplane & Motor Corporation also submitted this model, along with the F11C-1, to the Navy for tests with the result that a large order was placed. The F11C-1 was similar to the F11C-2 except that it was powered with a 700 h.p. 14 cylinder Whirlwind motor. For over ten years, the Curtiss Hawks have kept step with pursuit aviation and have met all requirements for up-to-date pursuit planes. But they are now facing the most severe test of all. Whether they meet it or not determines their future existence.

Against a 200 m.p.h. heavy armed bombing plane, any of the present pursuit planes are useless. To be effective at these speeds, the pursuit plane should be 50 m.p.h. or more faster than the bombing plane—under no conditions less than 25 or 30 m.p.h. faster. In fact, a 50 m.p.h. advantage against 200 m.p.h. planes is nowhere as effective as 50 m.p.h. against 100 m.p.h. planes.

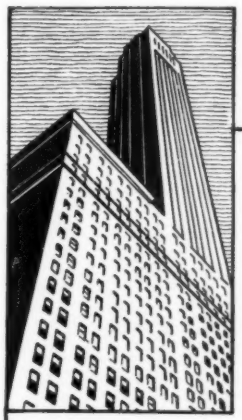
So far the only answer to these 200 m.p.h. bombing planes are the Boeing P-26A and the Curtiss Swift. Performance of these planes are still confidential but rumor has placed the top speed of the Boeing all the way from 250 m.p.h. to 300 m.p.h. However, it is probable that the top speed is nearer to 230 m.p.h.

If the Hawks can be redesigned to equal these speeds it will continue as an up-to-date fighting plane. If they can anywhere equal the speed of these monoplanes, they will be acceptable because the Army has always favored the biplane over the monoplane.

Aside from the matter of pure brute speed, the biplane has certain valuable qualities all its own. It has a powerful light wing structure, excellent maneuvering qualities and compactness.

If they can't, then the next year or two will find one of the oldest and most interesting type of post-war fighting plane demoted to ranks of private stunt plane and for exportation to a few foreign governments . . . then, what has happened to many another good plane, oblivion.

END.



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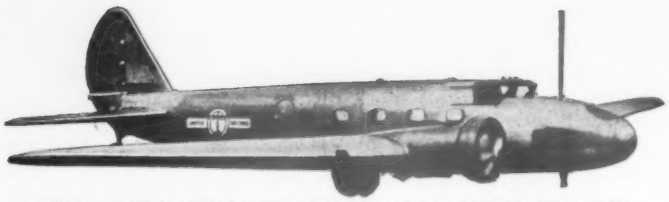

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An Airy Chat With the Editor

AVIATION development in the Orient, particularly in China, has been very rapid during the past two years and shows every sign of continuing. This being the case, the American aeronautic industries should prosper proportionately and our airplane factories should be busy even though we are not successful in interesting our own government in an intensive aviation campaign.

* * *

WE have a mighty fine article on Chinese aviation in this issue which should open the eyes of our readers to what is doing in China along the lines of military aviation. It is written by a man who is well acquainted with Chinese affairs, having lived there for many years and who understands the Chinese trend of thought very thoroughly. He is not only a writer but has been connected with the sales end of aviation for a considerable time.

* * *

THE debate, "Steel-Fuselage vs. Wood-Fuselage," still goes on merrily at our office. Nearly every day visitors to our office bring up this subject which, it appears, is engrossing the attention of many constructors at the present time. Without presuming to take sides in this argument, we must admit that the steel tube fuselage has proved to be no protection against fire, nor has any metal fuselage for that matter. On the other hand, we cannot deny the danger of wood splinters when a wood ship crashes. Wood veneer fuselage is lighter than the steel tube variety and is not subject to crystallization but, on the other hand, warping has not been eliminated.

* * *

LAWRENCE LESH, a noted Chicago engineer, who is distinguished by the possession of brains and originality in addition to his technical training—a rare combination in these days—breezed into the office the other day and delivered himself of a lot of new ideas which included a dissertation on the subject of tail-groups. His ideas are in agreement with those of many European engineers who have investigated the dire effects of "buffeting," and further, has had the courage to come out and say what he thinks about the contribution of buffeting to the several recent serious accidents to transports. Read and learn.

FURTHER proof that people read the Airy Chat. Every person listed in last month's Port of Missing Men answered within ten days of the date of issue. How's that for prompt work? Five readers wrote in to tell us the address of the Besler Brothers, three of which gave the wrong address by the way, and then the Besler Brothers wrote in themselves! Is this action or is it action?

* * *

HERE'S a new proposition that should be of interest to all of our readers and one that should save them many a dollar. The idea originates with Charles A. Bushnell, 1813 West 2nd St., Aberdeen, Wash.

I am considering the formation of a combined correspondence course and lending library, consisting of standard texts on aviation. According to my plans, the correspondence work would be conducted similar to college extension work; that is, regular graded texts that would be used with a weekly questionnaire, etc. The lending library would use the same books—with additions.

I plan a scale of tuition on some such plan as follows. All books under a five dollar list price, 25 cents per month. Five to ten dollar books, 50 cents per month; Above a ten dollar list, 75 cents.

These books, of course, could not be loaned until a returnable library fee equal to the cost of the books was paid. The correspondence work would be on the same basis but with an additional service charge of one dollar per month.

I see no reason why this idea could not be worked out with benefits to everybody concerned. I once had a course of this kind which was purely local (around Chicago).

* * *

BY the way. We have official information, direct from the Beslers, that they have discontinued experimental work on their steam-driven plane. The president of the company states that they are not interested in the aviation end of the development and that future work will be devoted to the steam propulsion of railway cars. This seems too bad, after their success in the preliminary flights. We only hope that they will eventually change their minds.

JUST a few days ago, I received word that my old student, Capt. Russell McDonald, is an engineering officer at Kelly Field, Texas. Capt. McDonald, always interested in aviation from boyhood, was a member of my first aeronautical class, which by the way, was the first aeronautical engineering class in this country. I'm mighty glad to hear from him and his success, as you can easily imagine. This course was a regular division of the Chicago Technical College, 'way back in 1911, 1912 and 1913. It is difficult to realize that this was more than twenty years ago. Perhaps I can prevail upon Capt. McDonald to tell us of that interesting period during which he was a test pilot for the U. S. Army Air Corps.

* * *

AMONG the many factors contributing to the success of aviation is that neglected link in the chain of elements—gasoline. Very little has been published in aviation magazines about that wonderful source of energy that drives the airplane and dirigible and yet, as you must acknowledge, there wouldn't be much flying if it were not for this magic petroleum product.

With this end in view, we have requested Keith J. Fanshier, a nationally known expert on the subject of petroleum marketing, to contribute several articles on gasoline and lubricating oils, their origin, distribution and relation to aviation. Airport managers, pilots and others will find much useful practical information in these articles which are both authentic and interesting.

* * *

READERS with a statistical complex will be much interested in the tabulated performance figures relating to the military planes of the various nations given in Mr. Brown's article in this issue.

As usual, the U. S. A. shows up very poorly in these comparisons although we are spending many times more money for our equipment than other nations. This will prove a great disappointment to the patriotic tax-payer who, through many sources of propaganda, has been educated to the false idea that America stands first in the air. If the recent airmail cancellations accomplished nothing else of value, they opened the eyes of the general

(*Concluded on page* 400)

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